

15 YEARS OF BT COTTON IN INDIA Admission of Failure Official Now!



FOR PRIVATE CIRCULATION ONLY

Coalition for a GM-Free India is a broad national network of organisations, scientists, farmer unions, consumer groups and individuals committed to keep the food, farms and environment of India free of Genetically Modified Organisms and to protect India's food security and sovereignty.

For more information:

Visit <http://indiagminfo.org> , www.indiaforsafefood.in

Coalition for a GM-Free India,

A-124/6, First Floor, KatwariaSarai, New Delhi 110 016.

Phone/Fax: 011-26517814

Email: indiagmfree@gmail.com

Facebook: www.facebook.com/GMWatchIndia

15 Years of Bt Cotton in India - LESSONS TO BE LEARNT

While it was in 1997 that open air field trials of Bt cotton were initiated in India, it was in 2001 that large scale illegal cultivation of Bt cotton was discovered by the regulators on thousands of hectares, much before biosafety of Bt cotton could be established and proven scientifically. A *fait accompli* was handed over. The Genetic Engineering Approval Committee (GEAC, subsequently renamed as Genetic Engineering Appraisal Committee), the apex regulatory body for gene technologies in the Ministry of Environment and Forests was subsequently forced to approve Bt cotton in March 2002 before its incapability to regulate is revealed fully for what it is.

By June 2017, when this report was written, India has therefore experienced 15 years of Bt cotton cultivation. While the regulators and the Union of India refuse to learn a lesson from the experience, several state governments are more aware of the pitfalls of the technology and its political economy. Today, India is talking about reviving non-Bt desi cotton and improvement of yields through other methods like high density planting.

The Coalition for a GM-Free India, which is a loose and large civil society platform that strives to keep India's food, farming and environment GM-Free, and to establish lasting solutions to various problems in our agriculture presents in this booklet a glimpse of these 15 years of Bt cotton cultivation in India, using official data mainly, in addition to a few published academic studies.

Background: On March 26th 2002, Bt cotton was officially approved for commercial cultivation, in the six states belonging to southern and central cotton cultivation zones of the country. In 2005, approval was provided for North Zone cultivation also. To this day, Bt cotton remains the only GM crop approved for cultivation in farmers' fields in the country. It is with Bt cotton that India gained the dubious distinction of being the 5th largest GM crop cultivating country in the world. Bt cotton, with the trade name 'Bollgard-I', developed by Mahyco-Monsanto Biotech Ltd (associated with the American multinational corporation Monsanto) is genetically engineered with the *Bacillus Thuringiensis* (Bt) protein that is toxic to the bollworm complex of pests. The Bollgard-I with a single Bt gene was followed in 2006 by 'Bollgard-II' with two Bt genes. By 2013, 1167 number of Bt cotton hybrids were introduced in the Indian market with regulatory approval. From a low initial uptake in 2002, Bt cotton has spread to over 93% of the cotton area by 2012 covering 11.2 million hectares. After touching 12.85 million hectares in 2014-15, cotton area subsequently declined in India to around 10.5 million hectares by 2016-17 mainly due to pest attacks (whitefly, pink bollworm etc.). Today, India also has a large area of herbicide tolerant Bt cotton being grown illegally by farmers, with the regulators and governments just twiddling their thumbs on the matter without any punitive action against anyone for this contravention of the law.

Bt cotton was brought in mainly on two grounds:

- That cotton is a pesticide-intensive crop (occupying 5% of India's agricultural land but consuming nearly 54% of pesticides used in our agriculture) and introduction of Bt cotton will bring down pesticide use in cotton farming;
- That the Bt toxin produced inside each cell of the cotton plant will fight against bollworm attack, killing the pests, thereby saving the crop from losses and increasing cotton yields.

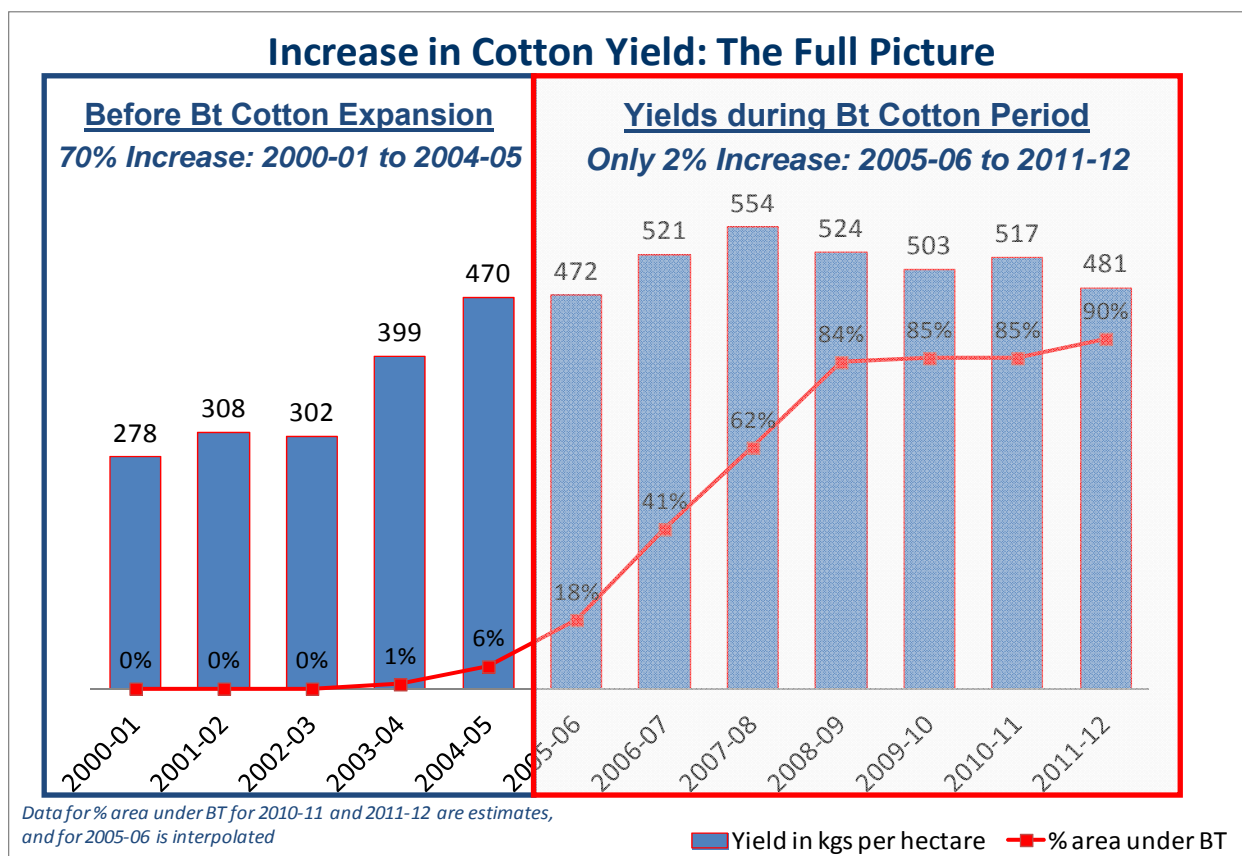
Here, we attempt to present evidence on these two claims, the reality with 15 years of Bt cotton, and also other important developments around Bt cotton, which should teach the policy makers some lessons, provided they choose to learn. The fact that India has gone in for only one GM crop so far, that too a non-food crop mainly, is the only bright spot in an otherwise fully dismal situation. China is in a similar position with GM crop cultivation - apart from opting for mainly public sector GM cotton that too in open pollinated varieties (not hybrids), China has been able to regulate its Bt cotton cultivation better, and have it confined only to designated provinces where bollworm was perceived to be a problem. Further, in the recent past, it has reduced its area of cultivation of Bt cotton.

1. Past 15 years' Yield and Yield Growth of Cotton in India

Bt cotton manufacturers, promoters and proponents and even some academic research institutes would like the world to believe that Bt cotton has been an unqualified success in India. Anything positive in the Indian cotton situation is attributed to the Bt technology introduced, and anything dismal is attributed to numerous other factors. They claim that India has become the second largest producer of cotton in the world due to Bt cotton and that our exports have increased significantly (here, the proponents conveniently forget that import-export related policy decisions have not had much to do with technology or production in the country).

Is there any truth in the yield claims of Bt cotton proponents? The following graph reveals the true picture with regard to yield increases in Indian cotton.

While Bt cotton was approved in 2002, the initial adoption was slow, and by 2004-05, only 5.6% of the cotton cultivated area was planted with Bt cotton. Yield was already rising sharply in the **pre-Bt cotton era** due to non-Bt hybrid seed, reduction in bollworm incidence from year 2000 and other factors. In the 5 year period from 2000-01, yield increased by **69%**. Just between 2002 and 2004, yields increased by 56%, when the area under Bt cotton was just around 6%. In the subsequent 3 years, yield increase was a meager 17%. From 2008 to 2012, yields declined, despite progressive increase in Bt cotton area.



Source: Cotton Corporation of India, <http://www.cotcorp.gov.in/statistics.aspx#area>

The fact that other factors (like hybrid seed source and not necessarily Bt technology) and increased irrigation for cotton may be contributing to yield increases were never acknowledged by the proponents of Bt cotton, who wanted all credit to go to transgenic technology. In Gujarat, 65% irrigated cotton area contributes to 84%, and 35% un-irrigated area contributes to 16% of the state's cotton production (Gujarat is the largest cotton producing state in India). In this state, the average productivity in irrigated cotton is 689 kg/ha lint whereas that in un-irrigated is a mere 247 kg, with both growing conditions using Bt cotton seed only. This clearly shows the important role that irrigation plays in contributing to yields.

Several micro-studies which projected significant yield increases in Bt cotton cultivation clearly did not control for various variables that affect yields – seed variety used (pure line variety or hybrid, what kind of hybrid, whether the seed came from cold storage etc.), irrigation and lack of irrigation, soil conditions, agronomic management practices adopted etc. One study which did look at different variables but was confined to just one village is from Vidarbha region of Maharashtra (rainfed). It showed that Bt cotton had higher production and gross value of output when grown as a stand-alone crop; however, on fields of small and marginal farmers, where cotton was usually intercropped with sorghum or other cereals and pulses, the relative income advantage

of Bt cotton declined, expenditure on chemical pesticides on Bt cotton was higher than for other cottons, and variability in production was also higher for Bt cotton¹.

It is also worth noting that the All India Coordinated Cotton Improvement Project (AICCIP) started recording from 2000 itself that bollworm incidence has come down significantly in different cotton growing regions of the country². If bollworm attack is not there on any cotton, how can the Bt technology contribute to yield increases in any case?

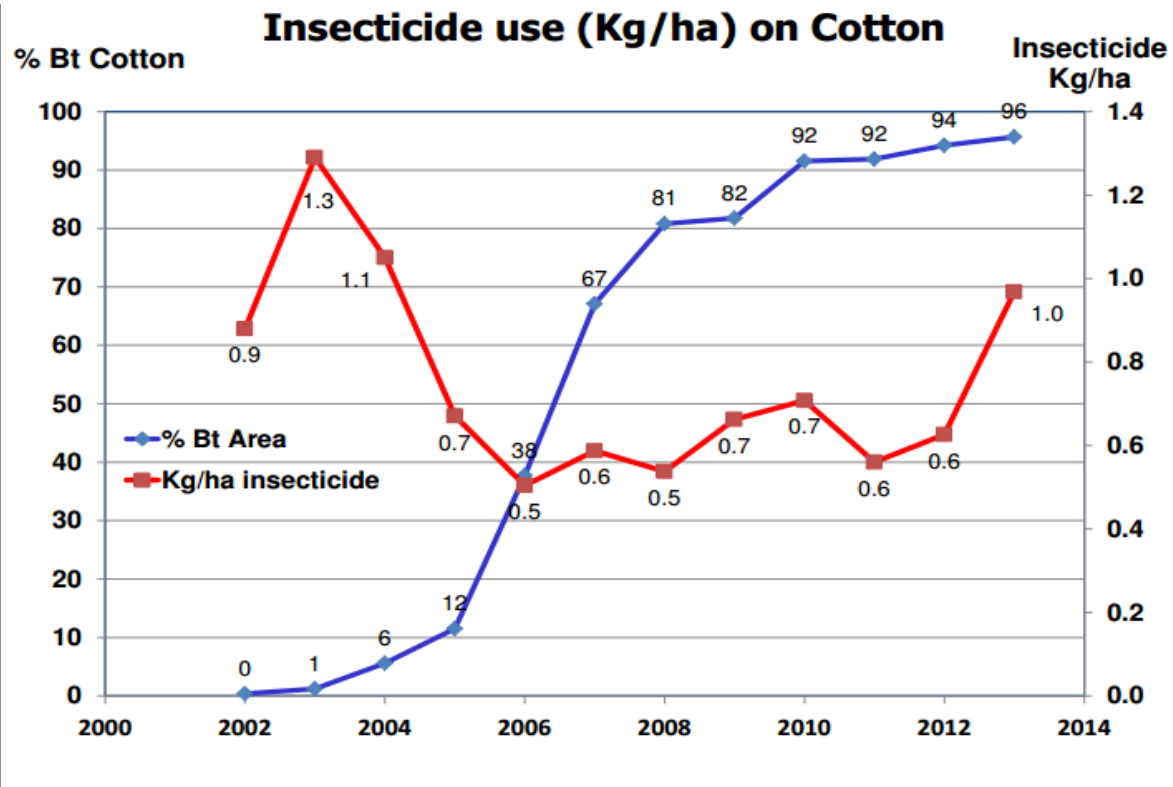
Dr K R Kranthi, a well known cotton scientist and former Director of Central Institute for Cotton Research (CICR, Nagpur) asserts that *regression correlation analysis between Bt cotton area and yields does not indicate any trends especially with data from 2006 to 2015*³. He notes that over the past 10 years, between 2006 and 2015, yields stagnated at 520+24 kgs lint per hectare, despite more than 90% area under GM cotton.

2. Pesticide Usage on Cotton in India – Trends

Let us now examine the main claim around inserting a pesticide in the form of the Bt toxin inside the cotton plant through genetic engineering – that it will reduce the need for pesticide sprays.

- Data from the Comprehensive Scheme (Directorate of Economics and Statistics, Ministry of Agriculture at <http://eands.dacnet.nic.in>) through which estimates of cost of cultivation of different major crops of India are calculated, shows that while insecticide usage was 0.88 kilos per hectare in 2002 when Bt cotton was introduced, the pesticide usage touched 0.97 kg/ha by 2013. This then is the picture with the intensity of pesticide usage.
- During 2006-2015, expenditure on insecticides increased by 2.3 fold from Rs. 1240/ha in 2006 to Rs. 2799/- per hectare in 2013.
- By 2013, total insecticide usage (volume) in cotton doubled to 11,598 metric tonnes compared to 4,600 MT in 2006 (when the real expansion of Bt cotton began) and 11,000 MT in 2000 (before the advent of Bt cotton).

Although there was an initial decline in the use of pesticides to control bollworms, overall pesticide usage has gone to the same level as compared to years before introduction of Bt. cotton. This was due to development of resistance in the targeted pest and increase in infestation of sucking pests. Following graph shows that per hectare usage of pesticides has increased by 11% after introduction of Bt cotton.



Source: "Biotechnologies for Cotton Production", KR Kranthi, CICR www.caionline.in/download_event_publications/56

Currently, illegal cultivation of HT (herbicide tolerant Bt) cotton in Gujarat and other states is also leading to increased use of weedicides like Glyphosate on cotton crop. Glyphosate is classified as a probable human carcinogen by United Nations' World Health Organisation.

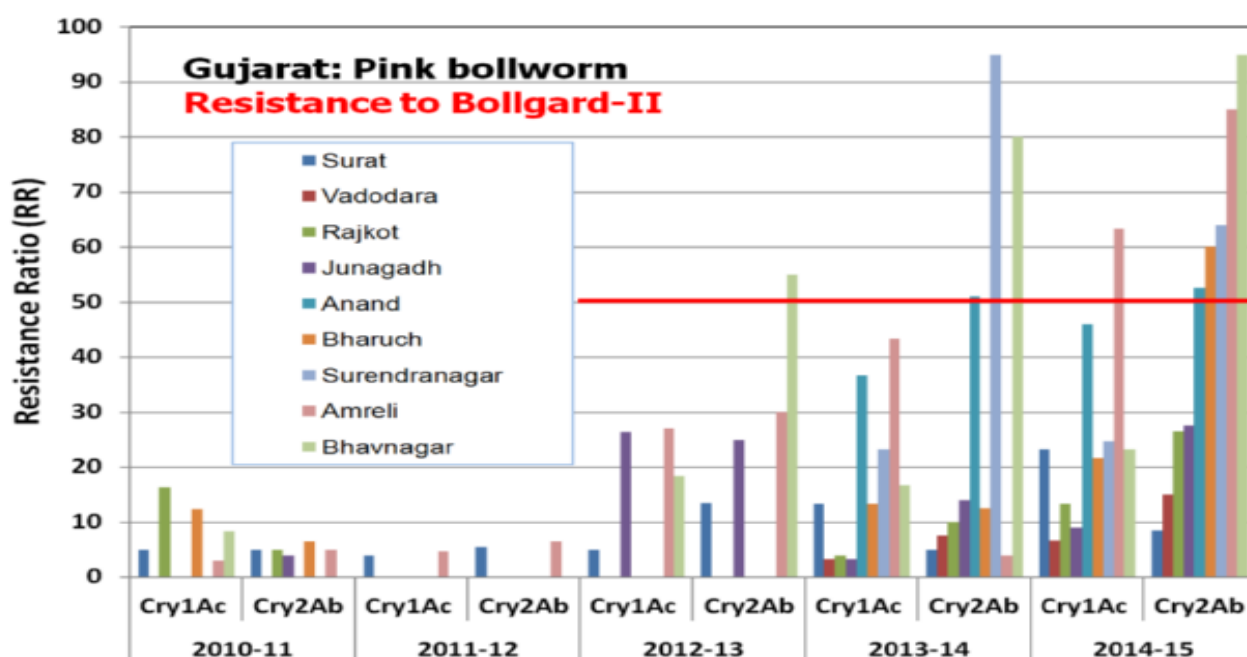
Toxins produced in the plant cells are also pesticides emitted into the ecology. It is important to note that scientists have estimated that ~1.2 kg of Bt toxin is added per hectare to the soil in each season of cultivation of Bt cotton (both through root exudates and crop residue). The Bt toxin in GM crops is 1000 times more concentrated than in Bt external sprays (which also in any case do not have a history of safe use). And the Bt endotoxin is produced in all parts of the plant continuously, as long as the season of cultivation is on and a living plant is in the field. The cumulative Bt cotton hectares grown in India from 2002 to 2016 are at least 100 million hectares – this means at least 100 million kilos of Bt toxin infused into the soils of cotton farms of India. It is not out of place to point out that if soil health is not maintained, farm livelihoods themselves become unsustainable.

3. Development of ‘Super Pests’ and New Major Pests

It was inevitable that target pests of Bt cotton will develop resistance to the Bt toxin/crop. Development of resistance to a particular toxin is a known phenomenon in Nature’s evolutionary process. Extensive exposure to high levels of toxin creates selection pressure which leads to development of resistance, irrespective of the fact whether the toxin is produced in a chemical factory (and then sprayed on the crop) or in the plant cell itself.

It was way back in early 2010 that Monsanto disclosed that the pink bollworm, a major target pest, had developed resistance to the Cry 1Ac toxin (Bt) in Bollgard I in Gujarat (the first State where Bt cotton was planted on a large scale illegally). It was seen as one more marketing ploy of the company back then, to shift licensee companies and farmers more quickly towards Bollgard II. Before long, even Bollgard II’s ineffectiveness in controlling this bollworm came to the fore. The losses incurred by the severe damage to cotton crop in several parts of the country in 2015 from pink bollworm infestation was reminiscent of losses 30 years earlier due to the pest⁴ – it is worth noting that Bollgard II’s effectiveness against pink bollworm remained for only 10 years then, if at all.

As evident from the graph below, there is wide spread development of resistance against two Bt. toxins being witnessed in all cotton growing districts of Gujarat.

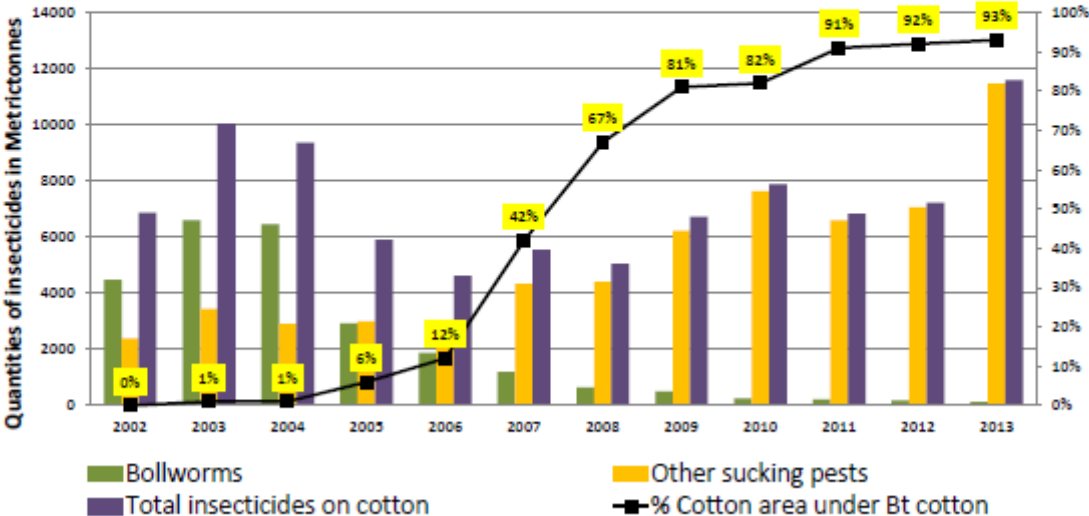


Resistance monitoring studies done at CICR have demonstrated that bollworm (*Helicoverpa armigera*), the target pest of Bt cotton, has developed tolerance for it. Other studies have also shown bollworm surviving and reproducing in Bt cotton both single gene and double gene Bt (Renjith et al, 2010).⁵

Further, there has been an emergence of secondary pests like sucking pests as major pests. In his 2011 report Dr. Kranthi states: *“Productivity in north India is likely to decline because of the declining potential of hybrids; the emerging problem of leaf curl virus on the new susceptible Bt-hybrids; a high level of susceptibility to sucking pests (straight varieties were resistant); problems with nutrient deficiencies and physiological disorders; and mealy bugs, whiteflies and miscellaneous insect problems that are likely to increase.”*⁶ His prediction came true. White fly attack on cotton led to major losses in North India the past few years.

The following graph clearly shows the picture with regard to where the increased insecticide usage is going (sucking pests which have become a major problem), and it is clear that the reductionist understanding of the technology and its claims, and the complex realities of crop eco-systems are showing up as real life bitter and harsh experiences for farmers.

QUANTITY of INSECTICIDES on COTTON in INDIA (2002-13)



Source: Central Institute of Cotton Research

4. Cotton Farmers' Crisis Remains Unabated: Increasing Cost of Cultivation and Continuing Suicides

Cotton farmers continue to be in deep crisis, notwithstanding any of the hype and false claims and promises made by the GM proponents. Several suicides in 2015 in Punjab were reportedly directly correlated to white fly attack in Bt cotton fields and consequent losses where farmers had to destroy their cotton fields by ploughing up the plants after making heavy investments in first trying to save the crop. This led to massive agitations by farmers for compensation for crop losses so that they can recover some of the costs incurred.

A 2015 University of California, Berkeley study found that annual suicide rates of farmers in rainfed areas are directly related to increase in Bt cotton adoption⁷. Here, total suicides per year per state were regressed singly on the state's averages of proportion of area sown to rainfed cotton, proportion of area with Bt cotton, average farm size and simulated average yield per hectare (includes weather effects), in the states of Andhra Pradesh, Gujarat, Karnataka and Maharashtra. Linear multiple regression showed suicides decreasing with increasing farm size and yield level, **but suicides increased with area under Bt cotton**. The study found that farmers were driven to suicide from increased costs of not being able to save seeds, increased chemical inputs and inadequate access to agronomic information. Using physiologically based demographic modeling methods that assess the dynamics of weather and pests on cotton yields, the study questioned the relevance of Bt cotton in its ability to control pink bollworm in rainfed cotton (most of India's cotton cultivation is rainfed). The above cited study is also important in that it shows that cost of production rises from 8% of the total revenues for average yields of around 1320 kg/ha to 21% for average yields of 500 kg/ha (and much higher proportion when yields touch 300 kg/ha). Low yields and high variability are clearly noted in the analysis, which exacerbate risks for farmers.

Data from the Ministry of Agriculture and Farmers' Welfare (from their Directorate of Economics and Statistics) shows that cost of cultivation of cotton was just Rs. 20,603/- per hectare in 2002, when Bt cotton was approved. However, this has touched Rs. 72434/- per hectare by 2013⁸. Not insignificant is the remarkable rise in chemical fertilizer cost, which rose from Rs. 1621 per hectare in 2002 to Rs. 8246/- per hectare in 2013. The cost of production of one quintal of cotton in India rose from Rs. 2220/- in 2002 to Rs. 3893/- by 2013. Overall, cost of production increased by 2.7 times between 2006 (when Bt cotton's real expansion began) and 2013, while yields were stagnant. The state of profitability for cotton farmers can be estimated from this. Meanwhile, the market interface for securing at least the minimum support price declared by the government continues to be highly unfavourable for farmers due to a variety of reasons, including policy apathy and agricultural Import-Export policies that are anti-farmer.

5. Alarming Increase in Chemical Fertiliser Use in Cotton

One of the most worrying aspects with regard to the past 15 years is the significant increase in the use of chemical fertilisers in cotton production in India, which went hand in hand with the use of Bt cotton seeds. Agriculture Universities, in their recommended Package of Practices, actively encouraged farmers to use more chemical fertilisers on Bt cotton, with other recommendations of lesser fertilizer use proffered for non-Bt cotton cultivation.

From 96 kilos a hectare on an average, chemical fertilizer use in cotton shot up to 224 kilos per hectare by 2013 (2.3-fold increase).

The total fertilizer use on cotton in India increased by 2.2 times from 1.2 million metric tonnes in 2006 to 2.68 metric tonnes in 2013.

Fertilizer cost for the cotton farmer increased 3.3-fold.

What is important to note is the casual way in which a former Co-Chair of GEAC, who is associated with biotech industry lobby bodies, remarked in the initial years of Bt cotton itself that “if the *area under advanced transgenic seeds increases to 10 per cent in a few years from the present level of 4 per cent, the country’s fertiliser consumption will increase 107 per cent to 220 kgs per hectare (ha) from the current levels (the latest available figure 2005-06), at 106 kgs per ha.*”⁹ This shows that the GM crop proponents do know that their technology is unsustainable, but still have no hesitation in making contrary claims.

It needs no further elaboration that such an increase in fertilizer use has implications for soil health, for the cost of production of cotton, for the public financing burden on the government given that chemical fertilisers are heavily subsidized to this day and most importantly, on continuing contribution to climate change. Increased chemical fertilizer use will also have implications for the pest and disease ecology of cotton crop.

6. Loss of Crop Diversity

Rapid erosion of agro-diversity was a problem even before the advent of Bt cotton, admittedly. However, Bt cotton also added to the problem in at least two ways: rapid expansion of cotton, led by the hype around Bt cotton meant that cotton cultivation area increased from 7.7 million hectares in 2002 to around 13 million hectares in 2014-15; two, almost all of India's cotton land began to be planted to American cotton species. Admittedly, a good part of the expansion of cotton area in the recent past between 2010 to 2014 (which also shrunk in the past 2 years after 2014-15 due to severe pest attack on Bt cotton) was also due to attractive prices that farmers realized in 2010-11.

The intrusion into the cultivation area of other crops (that too food crops), by cotton monocultures was very stark in the case of Gujarat. As a cotton scientist remarked in a seminar in 2011, "in South Gujarat, lot of sugarcane area has been shifted to cotton. In Saurashtra, extension of cotton area has been at the expense of pearl millet and groundnut. In North Gujarat kharif crop area under maize has decreased due to cotton. Pigeon pea and even paddy area has succumbed to cotton." Most of these displaced crops also produce fodder for animals in large quantities, and several also nurture the soil health. Monoculture of Bt cotton, thus, led to loss of crop diversity affecting farm ecology, animal health and soil health negatively.

Loss of diversity is not just about cotton crop eating into the area of other crops, but also changes in terms of species and varieties within cotton in India. Two types of old world cotton were traditionally grown in India, namely, *G. herbaceum* and *G. arboreum*. These native diploid *desi* cottons have been grown in India for more than 5000 years. They perform well in low rainfall conditions with almost no use of agro-chemicals and are suitable for local growing conditions as different varieties in different pockets of India.

A 2015 study shows that *G. arboreum* can generate similar net revenue and economic benefits as Bt cotton (*G. hirsutum*) for smallholder farmers, especially in rainfed conditions¹⁰.

Following table shows how *desi* cotton disappeared rapidly after the advent of Bt cotton in India¹¹.

Cotton Species	% in 1980	% in 1990	% in 2000	% in 2008	% in 2012
<i>G. arboreum</i>	20	30	17	4	3
<i>G. hirsutum</i>	54	48	69	90	96
<i>G. herbaceum</i>	14	12	11	5	1
<i>G. barbadense</i>	11	10	3	1	Neg.

Source: National Food Security Mission website, Ministry of Agriculture & Farmers' Welfare, Govt of India

Now with herbicide tolerant GM cotton being grown illegally in different parts of the country, intercropping and mixed cropping within a farm is affected too, given that those plants which have not been genetically modified to withstand the direct application of herbicide on the crop will get destroyed.

Diversity got destroyed in the market place too, resulting in monocultures in the fields. Farmers who depended on seed companies for their seed hardly had any choice in the retail shops, other than some prominent brands which were aggressively promoted. Non-GM cotton disappeared from the scene, reportedly also because the voices of farmers who were asking for other kinds of seeds became feebler. Where non-GM cotton seed was indeed demanded by farmers, anecdotal evidence shows that old low-quality seeds from cold storage was distributed, leading to unsatisfactory performance in the field.

Meanwhile, there have been reports of contamination of germplasm inside agriculture universities where breeder seed and other collections of germplasm are kept and maintained. The Sopory Committee, set up by the Ministry of Agriculture to look into the matter of Bikaneri Bt cotton being contaminated with Monsanto's event confirmed as much¹². The chances of contamination are high, as predicted by numerous cautionary voices, of all *hirsutum* species cotton varieties that are being maintained, either through biological means or through physical admixtures. This was inevitable.

It is obvious that these monocultures of crops and varieties within crops, that too at the genetic level, are bound to spell a disaster to sustainable farming. To even imagine that the Bt genes put into all of India's cotton crop and varieties will be successful and useful goes against the very basic science of pest management. Collectively, our scientific establishment showed that they are indeed unscientific in this matter by hyping the Bt technology as a silver bullet.

7. Monsanto and the Seed Industry Make Merry - Monopoly of an MNC over India's cotton seed established

Cotton and associated activities of spinning, weaving and wearing such hand-spun hand woven (*khadi*) cotton garments were the most galvanizing symbols in India's freedom struggle, led by Mahatma Gandhi when most of India shunned the economic imperialism imposed by colonial rulers of the country. Millions of Indians boycotted Manchester-millmade cloth and asserted the importance of self-reliance and sovereignty. Today, that very Cotton has moved into the hands of alien capitalist forces again.

Out of the 95% Bt-cotton-seed-sown area of India's cotton, at least 90-92% is estimated to be planted with Monsanto's proprietary technology, with a vast majority of land under Bollgard II, with some cotton land still planted to Bollgard I. Hundreds of crores of rupees have been collected by this multinational corporation (which has now been taken over by Germany-headquartered MNC Bayer), in the name of royalty and sub-licensing fees.

No other seed has been sold in India, in the aggressive and unethical manner that Bt cotton has been sold in the country by Monsanto-Mahyco and all the sub-licensees.¹³ Crores of rupees have been spent on marketing the seed, and academic studies are pointing out to the de-skilling of Indian farmers due to social learning overtaking environmental learning. Seed choices have become a fad, a study shows¹⁴. A misleading advertisement put out with the PR funds of the industry, got pulled up by Advertising Standards Council of India.¹⁵ Paid news, advertorials with fake success stories have been exposed in 2011 in Maharashtra¹⁶, with an earlier detailed report in 2005 exposing the entire marketing scandal around Bt cotton¹⁷.

With Bt cotton came a new hierarchy in the Indian seed industry – with Monsanto (Mahyco Biotech) being the technology provider and the Indian seed companies being the actual seed sellers, and the terms and conditions set by the technology provider mainly. Liability, whatever meager liability exists, appears to be on the Indian companies for any failure and not the technology provider.

NO LIABILITY EXISTS: In reality, for repeated losses for Bt cotton farmers each year, every year of the past 14 years, in some state or the other, it has mostly been taxpayers' funds that have been used to compensate farmers for their losses (to a tune of at least 10000 crore rupees as per our estimate). The compensation has been paltry, and the Bt cotton seed industry has gone away scot-free for numerous seasons of losses for farmers in these 15 years.

Another aspect to note is that Bt cotton cultivation in India happens completely through hybrids and not through varieties and the seed is from proprietary sources; this means

that farmers have to buy seed from companies every season. It was the Bt cotton seed market that drove the growth in the Indian seed industry with Bt cotton seeds having a share of at least 40-45% in the total annual turnover of the industry.¹⁸

From time to time, it was seen that a marketing strategy of spreading seed shortage rumours was used. In 2011, word spread from industry about expected shortage of Bt cotton seeds; farmers bought seeds in black at prices up to Rs 2700, three times the then MRP of Rs 930/container.

When state governments sought to enforce price regulation through new ordinances followed by state level legislations, the powerful seed industry lobby got the Essential Commodities Act amended so that cotton seed remained removed from the list of essential commodities, making state governments powerless. It was only in December 2015, that the Government of India was able to regulate prices of cotton seeds centrally. An additional attempt to bring in guidelines for compulsory licensing and royalty regulation did not succeed, however. A notification put out by the Ministry of Agriculture and Farmers' Welfare had to be put into abeyance in this regard after intense pressure from the industry and also from countries like the USA.

8. Indian Organic Cotton takes a beating

The volume of organic cotton within India's cotton is quite minuscule – just around 2%. But even this was a ray of hope, towards more sustainable cotton farming.

Within the organic farming world, India had an edge with the country being the leading organic cotton producer for the world. The growth in organic cotton production would have been impressive but for the adverse impact of Bt cotton's aggressive expansion. While India continues to account for 2/3rds of the global organic cotton production, the overall organic fibre production fell by nearly half.

After touching around 200 thousand metric tonnes of production in 2009-10, Indian organic cotton fell to around 100 thousand tonnes in 2011-12¹⁹. High costs of certification and challenges in maintaining organic integrity at a time when contamination possibilities from Bt cotton are immense were cited as reasons for the decline in India's organic cotton production.

On the ground, organic cotton farmers cite the lack of good non-GM organic cotton seed supply chains as the major problem for them. Organic cotton farmers' collectives informally complain about the contamination of seed supply to them and how it is affecting their market potential. This could very well be true. A study by CICR of so-called non-Bt cotton seed supplied for refugia planting showed that these seeds were mixed with Bt, had poor germination etc.²⁰ Organic cotton planters are being forced to deal with seed companies directly in placing their organic, non-Bt seed requirements well ahead of the season to be able to access any non-Bt seeds at all, and even here, there have been instances when Bt contamination of so-called non-Bt seeds has been seen.

In the years of rapid spread of Bt cotton (2008), owing to contamination of organic cotton with Bt cotton, APEDA had to suspend the accreditation of two certification agencies²¹.

On the other hand, various studies have repeatedly shown that organic cotton production can be more profitable for farmers, apart from numerous other environmental advantages²².

9. Other adverse impacts of Bt cotton

It is being reported in the recent past that the advent and expansion of Bt cotton in India had adversely impacted bee-keeping and honey industry in the country²³. Anecdotal reports indicate that farmers used to collect 3 to 4 rounds of honey (that added up to a honey production of 25-35 kilos) per beehive placed in cotton fields of indigenous cotton varieties earlier. Now, any honey production in cotton fields has stopped completely, especially after the advent of Bollgard II.

When reports of adverse impacts like the above emerge, the regulators and the concerned Ministries have refused to take up systematic investigations to arrive at the real picture. This was the case with reports about sheep (and even cattle) deaths after grazing on Bt cotton fields in the southern state of Andhra Pradesh in 2006 and 2007. To this day, many farmers in Haryana report milk yield decline and reproductive health problems in animals that are fed with Bt cotton seed cake meal. The regulators refused to take up any systematic investigation into the matter even though local departments of animal husbandry began cautioning farmers against grazing their animals in Bt cotton fields. The whole issue was sought to be discounted severely by the Central Government, its regulators and GM technology proponents in general. However, the Parliamentary Standing Committee on Agriculture, in the 15th Lok Sabha headed by Shri Basudeb Acharya, took note of a study done by Central Sheep & Wool Research Institute, Aviknagar in 2007-08 on 'Animal feeding trial on biosafety studies in Lambs using Bt cotton crop using seed meal'. Here, it was found that while Bt cotton seed consumption did not alter some attributes studied, it increased RBC, decreased WBC in blood and increased liver weight, testicle weight etc.²⁴ The Parliamentary Committee sought a professional evaluation of the findings from this CICR-funded study, and the possible causes and consequences.

It is often heard in arguments from GM crop proponents that India has been consuming Bt cotton seed oil which is mainly getting blended with other vegetable oils, and nothing untoward has been reported from the same. Yes, it is indeed true that Bt cotton seed oil has been at least 6% of India's overall edible oil consumption between 2012-2017, for instance. A similar or lesser proportion could have been the proportion of Bt cotton seed oil in the few years preceding this time period. However, the conclusion that no adverse impacts have been reported is unscientific. To begin with, lack of segregation and labeling on the GM product will make it next to impossible to correlate any impacts. Further, lack of evidence is not a proof of safety of GM cotton oil. The fact that such statements are made by so-called scientists is all the more alarming.

10. Failure of Bt cotton is now an official admission

Governments, especially the Government of India, kept lying about the benefits of Bt cotton for many years now, steadfastly ignoring all evidence of repeated crop losses, farm suicides, evidence on harmful impacts, seed monopolies and so on from the ground.

However, in an ongoing legal wrangle over cotton seed prices and royalties, the Government of India, in its January 2016 affidavit, admitted that the efficacy of GM cotton in resisting pest attacks has declined over the years. The Government noted that farmers are a worried lot having sown Bt cotton seeds purchased at a high price. It said that the crop is getting damaged due to pink bollworm incidence.

On 5/8/2016, responding to a Rajya Sabha Question on Non Bt cotton variety (Q No. 218), the Union Minister of Agriculture and Farmers Welfare admitted that non Bt cotton varieties were making a comeback. Further, he said that it is a fact that non-Bt varieties, especially of desi cotton species *Gossypium arboreum* are tolerant to moisture stress, water logging, salinity, resistant to majority of diseases and insect pests²⁵.

It was not just the government which admitted to the failure. Indian seed companies also demanded that Mahyco Monsanto Biotech take liability for failure of Bt cotton crop. These Indian companies wrote to MMB and feared that they might face huge claims of compensation due to Bollgard II's lack of protection against pink bollworm. Seed companies were reacting to notices that they received from regulators in state governments of Gujarat, Maharashtra, Karnataka, Andhra Pradesh, Telangana and Madhya Pradesh where Bt cotton crop was severely damaged in 2015.

Starting from 2015, state governments have been actively urging farmers to switch away from Bt cotton cultivation. This has happened in Telangana, Maharashtra, Andhra Pradesh, Karnataka, Haryana, Punjab etc. In 2016-17, non-Bt cotton made a comeback in India, with an increased share of the cotton land reportedly planted to non-GM cotton²⁶. Importantly, there has also been a revived effort at promoting *desi* cotton by some state governments as well as Central Institute for Cotton Research²⁷.

Conclusion

Cotton cultivation in India is coming back a full circle today, with the glory of desi cotton varieties being re-discovered.

Today, it is far more clearer that Bt cotton's benefit claims and hyped results were unfounded and exaggerated. It is official data and official admissions that pronounce this, and not just civil society voices or voices of suffering farmers.

It is also clear that Bt cotton had always meant a riskier proposition for Indian farmers, with increased cost of cultivation and stagnant yields. Newer pests, resistant pests, increased use of chemical pesticides and fertilisers, continuing cotton farmer suicides, increasing cost of cultivation, lack of choices with regard to seeds, seed monopolies built up, conflicts between farmers, farmers and companies, companies and companies, companies and governments, governments and farmers are all an important integral part of the story of fall-outs of Bt cotton these past 15 years.

It is also apparent that the shift back to sustainable cotton farming in India will take a long, arduous and uphill journey, despite the glaring failure of Bt cotton. There is severe shortage of non-Bt cotton seed, even as agriculture departments are encouraging farmers to shift to non-Bt and even desi cotton. It appears that our cotton germ plasm collections are contaminated. What is being sold as non-Bt cotton has presence of Bt toxin²⁸.

In a sense, the last 20 years or so of Bt cotton import, development and spread has been actually an expensive experiment at the cost of poor farmers of the country. Tough lessons have been learnt. It is only hoped that these lessons will not be forgotten in a hurry. The Bt Cotton story holds clear precautionary lessons to reject similar hype around other Genetically Modified crops as the inevitable solution.

REFERENCES

- ¹ Madhura Swaminathan and Vikas Rawal (2011): "Are there benefits from the cultivation of Bt cotton? A comment based on data from a Vidarbha Village". Review of Agrarian Studies. Vol.1, No.1 available at: http://ras.org.in/are_there_benefits_from_the_cultivation_of_bt_cotton_a_comment_based_on_data_from_a_vidarbha_village
- ² Reports of ICAR's All India Coordinated Cotton Improvement Project are available at: <http://www.aiccip.cicr.org.in/>
- ³ Kranthi K R (2016): "Fertilisers gave high yields. Bt only provided cover". Cotton Statistics & News. Cotton Association of India. No. 39. 27th December 2016, available on www.caionline.in
- ⁴ Kranthi, K R (2015): Pink Bollworm Strikes Bt Cotton. Cotton Statistics & News. No. 35, December 2015 http://www.cicr.org.in/pdf/Kranthi_art/Pinkbollworm.pdf
- ⁵ M. T. Ranjith, A. Prabhuraj, & Y. B. Srinivasa. (2010). Survival and reproduction of natural populations of *Helicoverpa armigera* on Bt-cotton hybrids in Raichur, India. *Current Science*, 99, (11) 1602-1606. Retrieved September 4, 2011, from <http://www.ias.ac.in/currsci/10dec2010/1602.pdf>
- ⁶ Kranthi. K R (2011). Part-3: 10 years of Bt cotton in India. <http://www.cotton247.com/news/ci/?storyid=2171>
- ⁷ Gutierrez AP, Ponti L, Herren HR, Baumgärtner, J, Kenmore PE (2015): "Deconstructing Indian cotton: weather, yields, and suicides". Environmental Sciences Europe 2015, 27, 12. DOI 10.1186/s12302-015-0043-8
- ⁸ 2013 is the latest year for which data is available in the public domain at http://eands.dacnet.nic.in/Cost_of_Cultivation.htm
- ⁹ Transgenic seeds to push up fertiliser consumption. Dilip Kumar Jha. March 4, 2009. Business Standard. <http://www.business-standard.com/india/news/transgenic-seeds-to-pushfertiliser-consumption/00/12/350768/>
- ¹⁰ Carla Romeu-Dalmau et al (2015): "Asiatic cotton can generate similar economic benefits to Bt cotton under rainfed conditions". Nature Plants. Article No. 15072. Published on 1st June 2015
- ¹¹ Status Paper of India Cotton, Directorate of Cotton Development, Ministry of Agriculture and Farmers Welfare, Government of India. January 2017. <http://nfsm.gov.in/StatusPaper/CottonStatus2017.pdf>
- ¹² Report of Dr S K Sopory Committee on BNLA 106 event, Indian Council of Agricultural Research, Ministry of Agriculture and Farmers Welfare, 2012. <http://www.icar.org.in/en/node/5511>
- ¹³ Companies provided free pesticides with the seeds, conducted feast for farmers, using religious leaders and respected villagers as spokespersons, extensive advertorials showcasing "fake" success stories of farmers, discounts for advance bookings and creating a perception that the seeds are in short supply
- ¹⁴ Stone, G D (2007): Agricultural Deskilling and the Spread of Genetically Modified Cotton in Warangal. Current Anthropology. Vol. 48, No.1, February 2007. https://pages.wustl.edu/files/pages/imce/stone/stone480102.web_.pdf
- ¹⁵ Baseless genetically modified cotton ads earn Monsanto flak. Dinesh C Sharma. January 14th 2012. India Today. <http://indiatoday.intoday.in/story/baseless-genetically-modified-cotton-ads-earn-monsanto-flak/1/168817.html>
- ¹⁶ Reaping Gold Through Cotton, and Newsprint. P. Sainath, The Hindu. May 10, 2012. <http://www.thehindu.com/opinion/columns/sainath/reaping-gold-through-cotton-and-newsprint/article3401466.ece>
- ¹⁷ Marketing of Bt cotton in India: Aggressive, Unscrupulous and False. Monitoring and Evaluation Committee of civil society groups, 2005. <http://www.greenpeace.org/india/Global/india/report/2005/9/marketing-of-bt-cotton-in-indi.pdf>
- ¹⁸ Seed companies reap rich harvest on Bt cotton wave, Sanjib Mukherjee, Business Standard. <http://www.business-standard.com/india/news/seed-companies-reap-rich-harvestbt-cotton-wave/465532/>

-
- ¹⁹ Organic cotton production declines in India as brands shift to Better Cotton Initiative. Jayashree Bhosale, Economic Times, March 11, 2014. <http://economictimes.indiatimes.com/markets/commodities/organic-cotton/articleshow/31803212.cms>
- ²⁰ Non Bt seeds provided by seed companies in India – are they suitable as refuse for Bt cotton? Current Science, Vol. 112, No. 10, 25th May 2017. <http://www.currentscience.ac.in/Volumes/112/10/1992.pdf>
- ²¹ Can Transgenics (GM) and Organic Farming Co-Exist in India? Alliance for Sustainable and Holistic Agriculture (ASHA) and Jatan. August 2014. http://www.fao.org/fsnforum/righttofood/sites/default/files/gm_and_organic_cannot_co-exist_final1.pdf
- ²² Ecological Agriculture in India – Scientific evidence on positive impacts and successes. ASHA, February 2015. <http://www.kisanswaraj.in/wp-content/uploads/2-Ecological-India-Book.pdf>
- ²³ Nod to GM mustard has beekeepers worried. The Tribune. June 5th 2017. <http://www.tribuneindia.com/news/punjab/nod-to-gm-mustard-has-beekeepers-worried/417760.html>
- ²⁴ “Cultivation of Genetically Modified Food Crops – Prospects and Effects”, 37th Report, 15th Lok Sabha, Committee on Agriculture (2011-12), August 2012. http://164.100.47.134/lsscommittee/Agriculture/GM_Report.pdf
- ²⁵ Rajya Sabha Questions <http://164.100.47.5/qsearch/QResult.aspx>
- ²⁶ <http://indianexpress.com/article/india/india-news-india/cropping-patterns-non-bt-desicotton-makes-comeback-in-north-west-india-2912422/> ; <http://www.financialexpress.com/market/commodities/demand-for-domestic-cotton-seeds-growing/254123/> ;
- ²⁷ Farmers report higher profits from Desi Cotton in CICR's initiative to replace Bt hybrids. Vivian Fernandes. 2016. <http://www.smartindianagriculture.in/farmers-report-higher-profits-from-desi-cotton-in-cicrs-initiative-to-replace-bt-hybrids/> ; <http://krkranthi.blogspot.in/2015/07/indias-own-native-cotton-long-live.html>
- ²⁸ http://www.business-standard.com/article/markets/maharashtra-govt-suspends-17-firms-sale-of-bt-cotton-seed-117051500990_1.html

WHAT DID WE WITNESS/EXPERIENCE IN THE PAST 15 YEARS OF BT COTTON CULTIVATION IN INDIA?

- Cotton yields have stagnated – the best yield growth was in years when Bt cotton had not expanded.
- Pesticide usage on cotton – overall volumes in the country as well as per hectare intensity – has increased after these 15 years compared to what it was when Bt cotton was first introduced. Insecticide usage has gone up from 0.88 kg/ha in 2002 to 0.97 kg/ha by 2013. Total insecticide usage more than doubled from 4600 Mt in 2006 (when expansion of Bt cotton began) to 11598 MT in 2013.
- It is estimated that more than 100 million kilos of Bt toxin has been infused into India's cotton farms with the cultivation of Bt cotton. Implications and effects of this on soil health are unassessed.
- Targeted pest – bollworm – has developed resistance to Bt cotton. This is particularly so with Pink Bollworm which is creating huge losses even in 'second generation' BT cotton.
- Fertilizer usage in India's cotton cultivation has gone up from 96 kg/ha (2006) to 224 kg/ha (2013), while total fertilizer usage in the country, on cotton, increased by 2.2 times.
- Cost of cultivation is increasing – agro-chemicals are contributing to this, amongst other factors.
- Evidence points to farm suicides increasing with area under Bt cotton. High variability in performance is noted in Bt cotton.
- Agro-diversity declined as (Bt) cotton expanded to around 12 million hectares in the country.
- Cotton (in the form of Khadi) which was a galvanizing successful symbol of India's freedom struggle had its seed controlled by an American multinational corporation – Monsanto, which has recently been taken over by Bayer – with at least 90-92% of India's Bt cotton land planted to its proprietary technology. Hundreds of crores of rupees have been collected in the name of licensing/technology fees and royalty.
- Indian organic cotton which was witnessing impressive growth, and was showing the path to sustainable cotton farming, took a severe beating with the push of Bt cotton.
- Other adverse impacts seem to be ignored and uninvestigated – these include impacts on livestock, human health and honey production.

It is only in the recent past that Governments in India are admitting to the failure of Bt cotton. There are hard cautionary lessons to be learnt from these 15 years of the bitter harvest of Bt cotton in India, so that we don't repeat the mistakes. That too at the expense of hapless Indian farmers.