

10 Years of Bt Cotton: False Hype and Failed Promises

Cotton farmers' crisis continues with crop failure and suicides

- Coalition for a GM-Free India¹

Ten years after Bt cotton officially entered India, its manufacturers and promoters would like the world to believe that it is an unqualified success. The false hype is typified by recent advertisements by Mahyco-Monsanto claiming “Bollgard boosts Indian cotton farmers’ income by over Rs.31,500 crores,” which was pulled up by Advertising Standards Council of India for false information. The reality is starkly different.

The cotton farmers are in deep crisis after ten years of Bt cotton. The spate of farmer suicides in 2011-12 has been particularly severe among Bt cotton farmers. The extensive crop failure has exposed the false hype and advertising, often repeated by policymakers and regulators. In Andhra Pradesh, out of 47 lakh acres planted with Bt cotton during Kharif 2011 season, the crop failed in 33.73 lakh acres as per the state government estimates in December 2011². This means two-thirds of cotton area had yield loss of more than 50%! In Maharashtra, the bad performance of cotton crop has led to lowering of the production estimates significantly in spite of increase in the area of cotton cultivation.³ The cotton farmer crisis has forced the Maharashtra government to take the unprecedented step of declaring Rs.2000 crore as compensation package. Maharashtra has seen the highest number of farmer suicides (3141 in 2010), particularly in the cotton-growing belt of Vidarbha and Marathwada.

This is a wake-up call for farmers, Parliamentarians, policy-makers and media to closely examine the cotton crisis and critically re-assess the Bt cotton experience, particularly in the context of the 10th anniversary of the approval of Bt cotton crop in India.

1. Background of Bt cotton in India

On March 26th 2002, Bt cotton (the first genetically modified crop in India) was officially approved in India for commercial cultivation, in the six states belonging to southern and central cotton cultivation zones of the country. Bt cotton, with the trade name Bollgard-I, developed by Mahyco-Monsanto Biotech Ltd is genetically engineered with the *Bacillus thuringiensis* (Bt) gene with a protein that is toxic to the bollworm pest.

The Bollgard-I with a single Bt gene was followed in 2006 by Bollgard-II with two Bt genes. Currently Bt cotton hybrids expressing six events (different combination of 3 Bt genes) have been commercialized in India. These have been introduced into 780 cotton hybrids. From a low initial uptake in 2002, Bt cotton has spread to over 85% of the cotton area, covering 9.4 million hectares in 2010-11.⁴

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² Crop-wise extent of damage released by A.P. Dept. of Agriculture, reported in Eenadu, December 30, 2011

³ PTI Report “USDA cuts forecast for India’s cotton output”, *Financial Express*, Jan 2, 2012

⁴ Jishnu.L (2011). The cotton saga unravels. <http://www.downtoearth.org.in/content/cotton-saga-unravels>

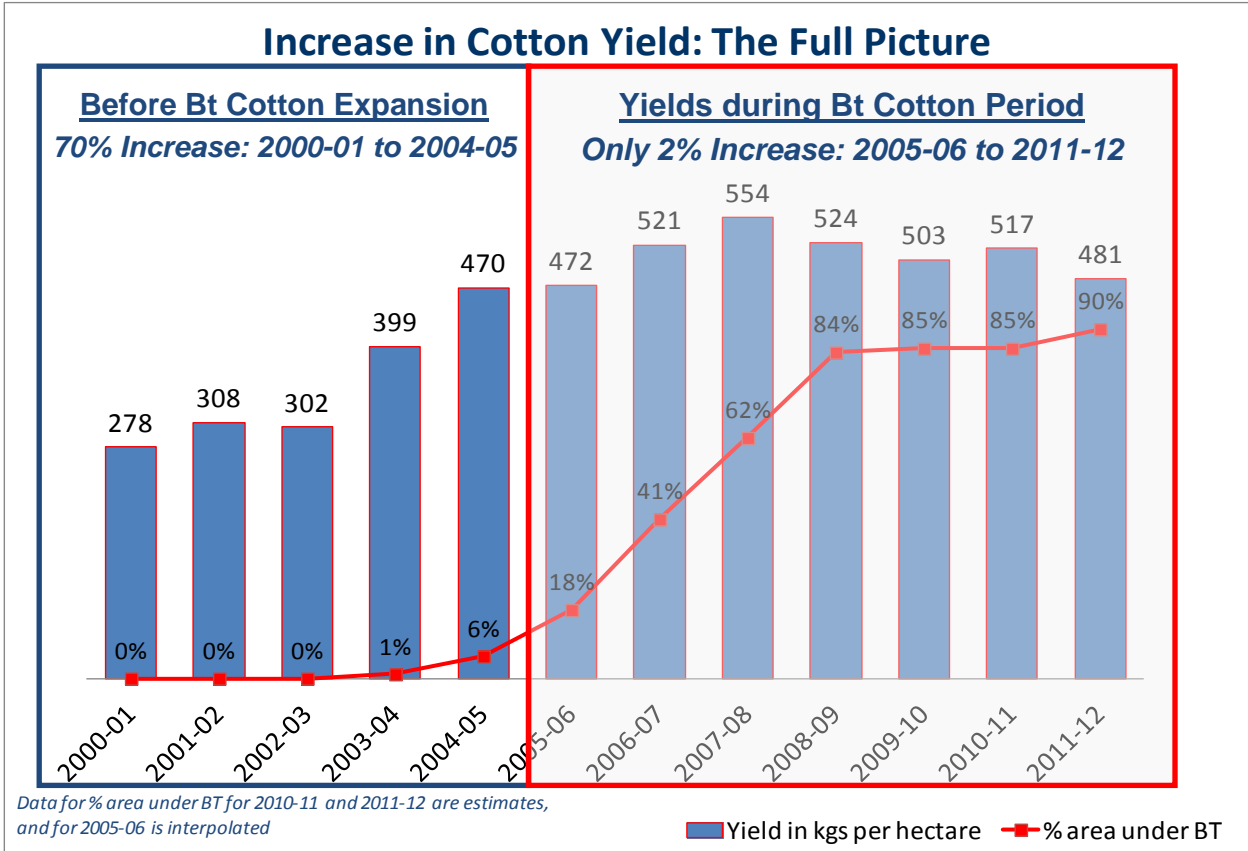
Bt cotton was introduced by the biotechnology industry with the lure that it will drastically reduce the use of synthetic pesticides on cotton and also give high yields (ostensibly from preventing crop losses rather than any increased intrinsic yield potential), providing farmers with enhanced income. Bt cotton is, in many policy and industry circles, being touted as the success story that needs to be replicated with other crops notwithstanding the desperate suicides that continue unabated among cotton farmers. We put forth in this document some of the crucial facets of the Bt cotton story.

2. Myth of high yields

A strong focus of the Bt cotton propaganda is that Bt cotton has been primarily responsible for doubling the cotton production in India, and for phenomenal increase in yields. However, closer examination of the data shows a different picture.

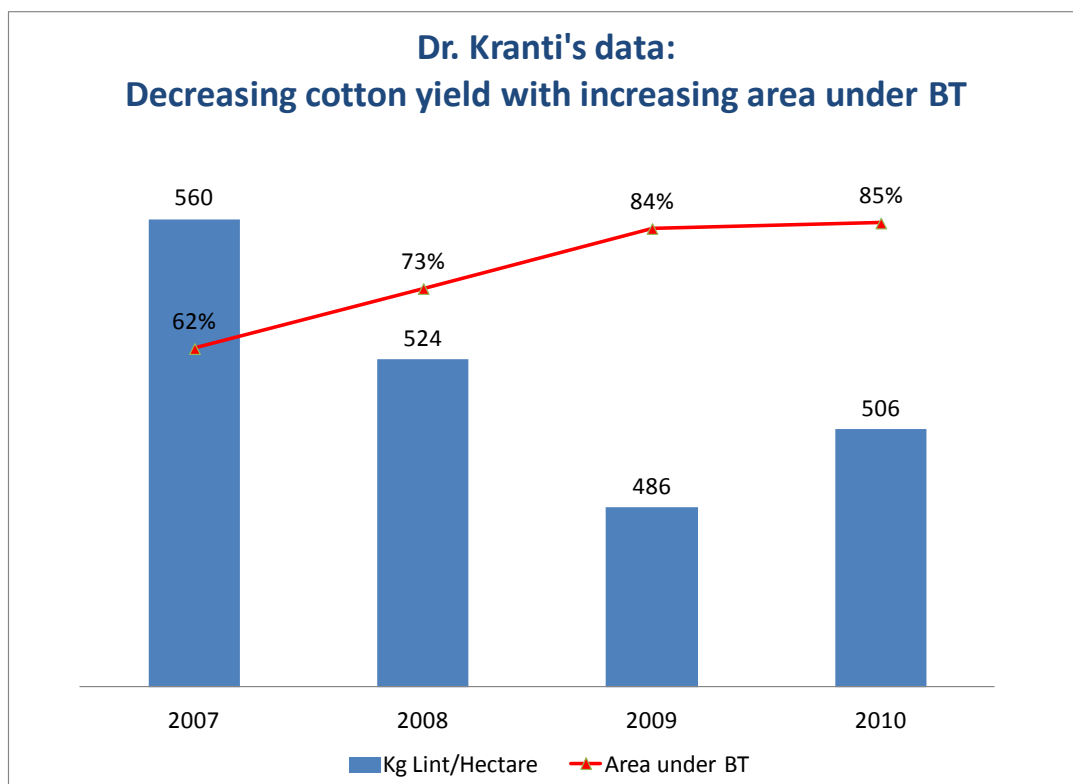
Cotton Yield gains – pre-Bt and post-Bt

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. The graph below is based on yield data from Cotton Corporation of India⁵ and area under Bt cotton adapted from Dr. K.R. Kranthi, Director of Central Institute of Cotton Research. Considering the period from 2000-01 as the pre-Bt Cotton expansion period and the phase from 2005-06 to 2011-12 as the Bt cotton period, a different picture of the yield gains emerges.



⁵ Cotton Corporation of India, State-wise Area, Production, Yield. <http://cotcorp.gov.in/state-operations.aspx>

- Yield was already rising sharply in the **pre-Bt cotton era** due to non-Bt hybrid seed and other factors. In the 5 year period from 2000-01, yield increased by **69%**.
- In the Bt cotton period starting from 2005-06, an increase in yield is seen for a couple of years, showing a moderate 17% increase over 3 years up to 2007-08 (554 kg/ha compared to 470 kg/ha). But the yields show a downward trend since then. **Presently, the cotton yields have reached pre-Bt levels – 481 kg/ha compared to 470 kg/ha.** In fact, the yield estimate of 481 kg/ha for 2011-12 is only an initial estimate from the Cotton Advisory Board and the actual number is likely to be lower.
- This trend is corroborated in the paper of Dr. Keshav Kranthi (CICR) reviewing the 10 years of Bt Cotton. **“The main issue that worries stakeholders is the stagnation of productivity at an average of 500 kg lint per ha for the past seven years.** The gains have been stagnant and unaffected by the increase in area of Bt cotton from 5.6% in 2004 to 85% in 2010. The yield was 463 kg per hectare when the Bt cotton area was 5.6% in 2004 and reached a mere 506 kg per hectare when the area under Bt cotton increased to 9.4 M hectares at 85% of the total 11.1 M hectares.”⁶
- The same paper provides numbers which show “progressive problems and stagnation of production and productivity” The data, shown pictorially indicates declining productivity, and the trend would be even clearer if the 2011 numbers are included. Please note that there are small differences in the numbers put out by the Cotton Advisory Board and CICR but these do not impact the trends.



⁶ Kranthi. K (2011). Part-3: 10 year of Bt in India. <http://cotton247.com/news/ci/?storyid=2159>

Factors contributing to yield trends

It is clear from the above analysis that the revolutionary contribution of Bt cotton to the productivity is a myth. The trend shows that the more stable yield gains are from the pre-Bt cotton period – which can be attributed to various factors.

- Maximum yield gains were from Gujarat which brought 0.6 to 0.7 million hectares of new land under cotton (previously under groundnut) irrigated by a 100,000 new check dams (Kranthi.K, 2011).
- In 2000, 40% of cotton area came under hybrids and the rest was under varieties. By 2009, 85.5% area came under hybrids and the rest were under cotton varieties.
- The use of irrigation facilities, bringing new lands under Bt cotton, low pest activity, well distributed rainfall, the overwhelming shift towards hybrid cotton and introduction of pesticides with novel modes of action are important factors that helped cotton productivity, not just the introduction of the novel Bt gene.^{7 8}

3. High input requirement of Bt Cotton

The high-input requirements of Bt cotton in terms of fertilizers and water make the crop an increasingly risky investment for small farmers, particularly in rainfed areas which constitute a majority of the cotton-growing area in India. The depletion of nutrients and soil health is also a related problem.

Fertilizer requirement in Bt cotton and soil health:

- According to Dr C D Mayee (ISAAA Board Member) and former Co-Chair of GEAC, “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
- According to recommendations to farmers from ANGRAU, one of the few universities doing research on Bt cotton and Non-Bt cotton, Bt cotton requires 15% more fertilizers. (Agricultural Almanac, ANGRAU 2009)
- According to Dr.Kranthi there has been depletion of nutrients in the soil due to repeated cultivation of Bt cotton hybrids, which draw more nutrients and water from the soil. The crop is exhibiting nutrient deficiency especially in rain-fed zones where wilt and leaf-reddening problems are also getting more severe over the years.¹⁰

⁷ Kranthi. K (2011). Part-11: 10 year of Bt in India. <http://cotton247.com/news/ci/?storyid=2159>

⁸ Kumar.V (2011). Navsari Agricultural University, Gujarat. Bt Cotton : A Gujarat experience & issues, presented at State-level Dialogue on Emerging Concerns in Gujarat Agriculture, Vadodara, July 21-22, 2011

⁹ Jha, D (2009). Transgenic seeds to push up fertiliser consumption. <http://www.business-standard.com/india/news/transgenic-seeds-to-pushfertiliser-consumption/00/12/350768/>

¹⁰ Kranthi, K. (2011). Part III- 10 year of Bt in India. <http://www.cotton247.com/news/ci/?storyid=2171>

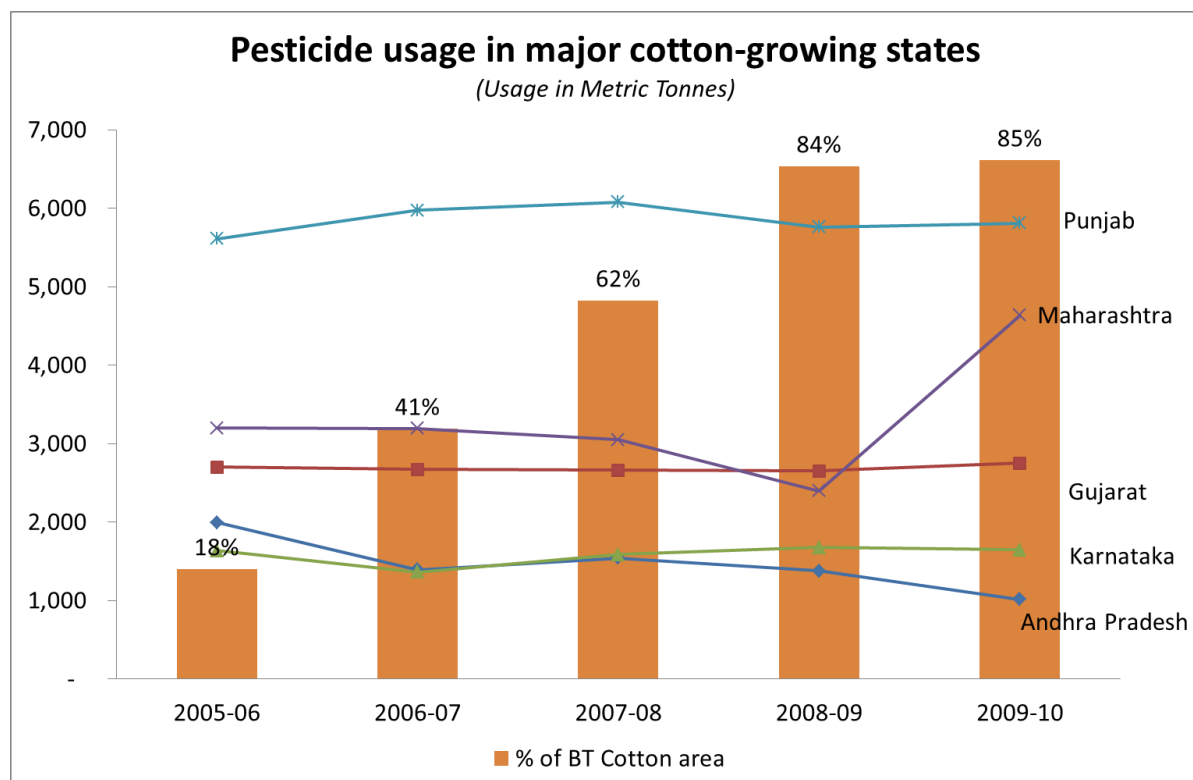
Irrigation and water requirement in Bt cotton

- Bt hybrids need to be irrigated more frequently at peak bolling around October when the need for water is high and temperatures are also high. It may otherwise lead to wilting. Bt hybrids need more water in a short span because of shorter duration (reproductive phase) *vis-à-vis* conventional hybrids. This is problematic particularly in the rain-fed cotton areas.
- In Gujarat, 65% irrigated cotton area contributes 84% and 35 % un-irrigated area contributes 16% of the state's cotton production. The average productivity in irrigated area is 689 lint kg/ha whereas that in un-irrigated is a mere 247 kg.¹¹

4. Pesticide Usage, Pest Resistance and Emergence of New Pests

While Bt cotton came in with the promise of drastically reducing the use of pesticides in cotton, the experience of these 10 years shows that there is no sustained reduction in pesticide usage. The experience of farmers clearly shows that while a lower number of pesticide sprays was required in the first two years of Bt cotton adoption, thereafter the pesticide requirement has increased, and now the number of pesticide sprays required is equal to or more than that in the pre-Bt cotton period.

- Cotton-growing states show no reduction in pesticide usage



Source: Directorate of Plant Protection, <http://ppqs.gov.in/lpmPesticides.htm>

¹¹ Kumar.V (2011). Navsari Agricultural University, Gujarat. Bt Cotton : A Gujarat experience & issues

Table: Pesticide usage in Metric Tonnes technical grade.

	2005-06	2006-07	2007-08	2008-09	2009-10
Andhra Pradesh	1997	1394	1541	1381	1015
Gujarat	2700	2670	2660	2650	2750
Karnataka	1638	1362	1588	1675	1647
Maharashtra	3198	3193	3050	2400	4639
Punjab	5610	5975	6080	5760	5810
Madhya Pradesh	787	957	696	663	645
All India	39773	41515	43630	43860	41822

The pesticide usage trends in the major cotton-growing states of Gujarat, Maharashtra, Andhra Pradesh, Punjab, Madhya Pradesh and Karnataka are shown above. While Maharashtra shows a significant upward trend from 3198 MT to 4639 MT, the other states show only marginal change, except for the downward trend in Andhra Pradesh.

- **Increased use of low-volume pesticides:** This same period has seen an enormous increase in the use of low-volume pesticides which require a much smaller quantity per acre. Therefore, the statistics of pesticide usage in metric tonnes in fact masks the increased use of pesticides.
- **Pink bollworm becomes resistant:** In early 2010, Monsanto disclosed that the cotton pest -pink bollworm- had developed resistance to the Cry 1Ac toxin (Bt) in Bollgard I in Gujarat¹² (the first State where Bt cotton was planted commercially).
- **Bollworm resistance to Bt:** 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).¹³
- **Emergence of secondary 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.*”¹⁴
- **Mealy bug menace:** According to Dr.Kranthi, a mealybug not observed in India before, has spread in the cotton regions and farmers have been spraying “extremely

¹² Sharma, D (2010). Bt cotton has failed, admits Monsanto. India Today, March 6, 2010
<http://indiatoday.intoday.in/site/Story/86939/India/Bt+cotton+has+failed+admits>

¹³ 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>

¹⁴ Kranthi.K (2011). Part-3: 10 years of Bt in India. <http://www.cotton247.com/news/ci/?storyid=2171>

hazardous” pesticides to eliminate this hard-to-kill pest. The prolific spread of Bt cotton hybrids has created a conducive climate for the rapid spread of this pest.¹⁵

- **Pesticide expenditure increases:** At a meeting of the GEAC in early 2011, Dr KR Kranthi cautioned about the lack of refugia and resistance management. In his report to the MoEF, he said that with 90% of cotton area under Bt, resistance will develop sooner than later. There has been emergence of new sucking pests and pesticide expenditure has risen from Rs 597 crore in 2002 to Rs 791 crore in 2009”.¹⁶

5. Manipulation by Seed Companies

- **Aggressive and unethical promotion:** No other seed was sold like Bt cotton has been sold in the country by Mahyco-Monsanto.¹⁷ One such misleading advertisement was recently pulled up by Advertising Standards Council of India. ¹⁸ Paid news, advertorials with fake success stories have been exposed in 2011 in Maharashtra.
- **Windfall profits for seed companies:** Bt cotton cultivation in India is 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. Bt cotton seed market is about Rs. 4000 cr. out of the total seed market of Rs. 10,000 crores.¹⁹ In 2011, word spread from industry about projected shortage of Bt cotton seeds; so farmers bought seeds in black at prices up to Rs 2700, three times the MRP of Rs 930.
- **Monopolistic control over seed market:** An estimated 93% of the seed represents the proprietary technology of Monsanto (Bollgard I and Bollgard II). Rs 1600 crores have gone from cotton farmers as royalty to one company, Monsanto.
- **Exorbitant Seed prices:** The monopoly control by one company has led to exorbitant pricing of Bt cotton seeds which were initially priced between Rs 1650-1800 for 450 gms of Bt cotton seeds (in 2004), as against Rs 350 for hybrid seeds and less than Rs 100 for desi cotton seeds.²⁰ After the seed prices were brought under control through the MRTP Act and Essential Commodities Act, Monsanto has taken the A.P. and Gujarat governments to Court to decontrol seed prices.

¹⁵ Mudur.G.S (2010) Cotton lessons for Bt brinjal. The Telegraph, February 16, 2010.
http://www.telegraphindia.com/1100216/jsp/nation/story_12110833.jsp

¹⁶ ibid

¹⁷ 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

¹⁸ Sharma.D (2012). Baseless genetically modified cotton ads earn Monsanto flak. India Today, 14 Jan 2012

¹⁹ Mukherjee,S.(2012). Seed companies reap rich harvest on Bt cotton wave. Business Standard, Feb 23, 2012.
<http://www.business-standard.com/india/news/seed-companies-reap-rich-harvestbt-cotton-wave/465532/>

²⁰ Sainath.P, (2009). The largest wave of suicides in history. Counter-Punch, February 12, 2009.
<http://www.counterpunch.org/2009/02/12/the-largest-wave-of-suicides-in-history/>

6. Conclusions

- The hype around Bt cotton as revolutionizing the cotton production in India is clearly wrong. The contribution of Bt cotton to the productivity is questionable, with gains in cotton productivity being steady and impressive in the pre-Bt cotton phase.
- The wide-scale adoption of Bt cotton in India has been due to various reasons which include aggressive promotion, often with the involvement of state agencies, wide publicity to the initial short-term benefits with respect to bollworm incidence and frustration of farmers with pesticide usage, and unavailability of non-Bt seed. But the adoption of Bt cotton has been wrongly used as an indicator for its success.
- The distress among cotton farmers has clearly continued after widespread Bt cotton adoption, especially in rainfed areas – as shown by farmer suicides, crop failures and rising debt.
- The negative impacts of Bt cotton are being clearly documented and articulated including by government scientists – nutrient depletion, impact on soil health, pest resistance, emergence of new pests – and these are already showing serious impact on the cotton crop and the farmers. However, no nuanced analysis is allowed to be established in the face of aggressive PR tactics of the proponents.
- It should be seen by policy-makers that Bt cotton has not been a magic bullet for sustaining either farmer incomes or productivity. At best, it is a technological input that has shown moderate short-term gains that have already disappeared.
- The Bt Cotton story holds clear precautionary lessons to reject similar hype around other Genetically Modified crops as the inevitable solution.
- There exist more sustainable and farmer-friendly solutions such as Non-Pesticidal Management in A.P. which has expanded through the state government's Community Managed Sustainable Agriculture program registering a 125-fold increase in 6 years (from 25000 acres in 2005 to 32 lakh acres in 2011). There have been no suicides among the farmers who have adopted this model.

In summary, the story of Bt cotton is clearly that of false hype and failed promises. Bt cotton has failed to meet its promise in terms of sustained yield gains, pest protection and reduction in pesticide usage. It is time for the government, scientists and policy-makers to reject the hype around Bt cotton, and focus on sustainable solutions and pro-farmer measures to achieve production, environmental safety and farmers' welfare that are long-lasting.

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