

A Decade of Bt Cotton experience in Karnataka: 2002 to 2012

Report by GM-Free Karnataka Movement

Bt Cotton (an insect-resistant transgenic cotton) was officially allowed for commercial cultivation in Karnataka in 2002 when the regulatory body in the Government of India – Genetic Engineering Approval Committee (GEAC, subsequently renamed as Genetic Engineering Appraisal Committee) allowed three Bt Cotton hybrids belonging to Mahyco-Monsanto to be commercialised in the South and Central zones of cotton cultivation in India (on March 26th 2002). This year, 2012, marks a decade of officially-approved Bt cotton cultivation in India and GM-Free Karnataka Movement seeks to bring forward many false claims and failed promises related to Bt cotton on this occasion (way before the official regulatory approval, it was documented that biosafety norms were being violated in the field trials of Bt cottonⁱ; trial farmers were shown to be selling produce from the trial plots in the open market whereas biosafety norms clearly require for all the material in the plot to be destroyed by burning – the saga of such violations continues unabated to this day, including in Karnataka). The following pages try to present a picture of cotton and specifically Bt Cotton in India and Karnataka, with particular emphasis placed on official records obtained from various government/public sector sources, which addresses the usual contention of bias in NGO or industry studies on the subject in addition to a survey taken up with Bt cotton and non-Bt cotton farmers, to get a comparative picture of Kharif 2011.

Karnataka occupied 4.51% of cotton area in the country in 2009-10, with a 3.61% contribution to the production at the all-India level in the same year (Source: Directorate of Economics and Statistics, Department of Agriculture & Cooperation, Ministry of Agriculture, Government of India). Around 20% of its cotton land is reported to be under irrigated conditions.

Coming to Bt cotton area within the total cotton cultivated area in the state of Karnataka over the years, the following is the picture, showing that Bt cotton adoption has been much slower in this state than elsewhere.

Table: %age area of Bt Cotton in the total cotton area of Karnataka – 2002 onwards

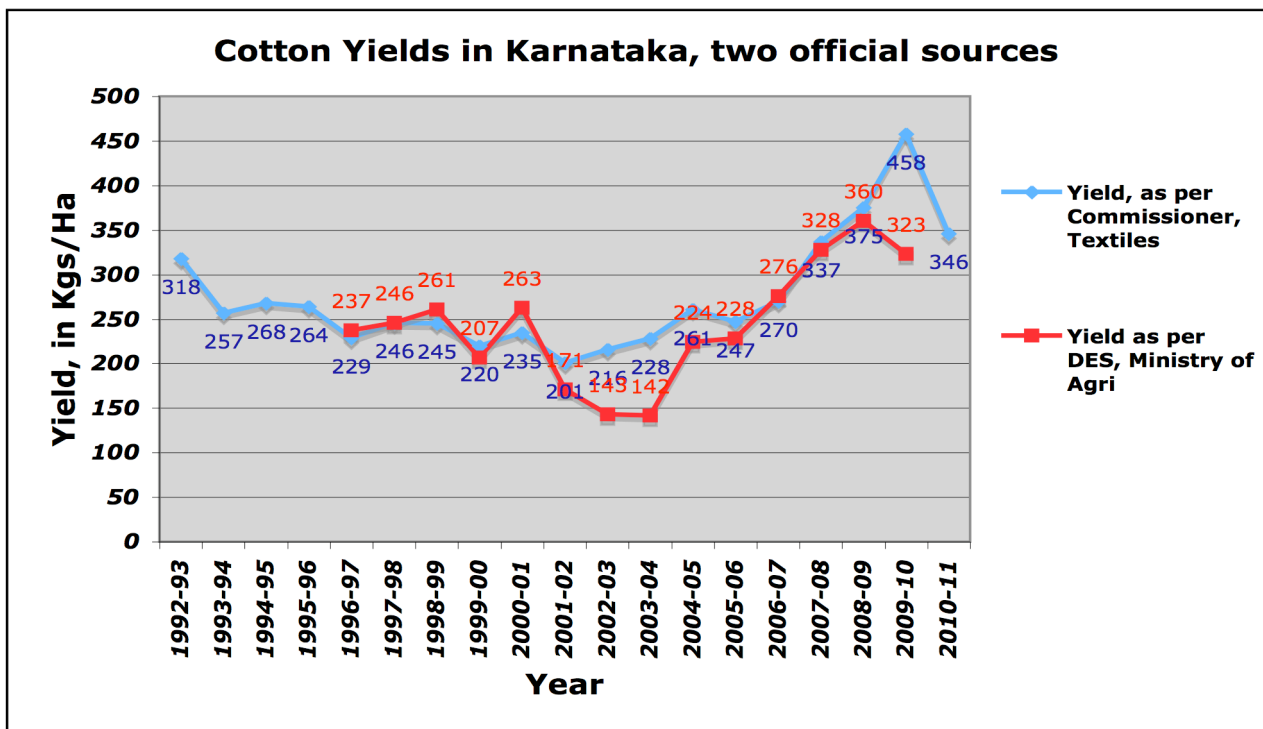
	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
Total Cotton extent	0.393	0.313	0.521	0.413	0.378	0.388	0.335
Bt Cotton extent	0.0021	0.003	0.0343	0.0293	0.08	0.146	0.172
%age	0.53	0.96	6.58	7.09	21.16	37.63	51.34

Source: Compiled from <http://www.cotcorp.gov.in/statistics.asp#areal> and Khadi, Santy & Yadav, "Cotton: An introduction" in *Biotechnology in Agriculture & Forestry*, 2010, Volume 65, 1-14, Springer-Verlag – Data in million hectares

In 2009, Bt cotton was reported to have been planted on 63% of Karnataka's cotton landⁱⁱ (Nemes, 2010). Nemes reports that in 2009-10, the coverage of cotton varieties decreased to 125-130 thousand hectares (out of a total cotton cultivation area of 416000 hectares which means only 30%) from around 215000 hectares in 2002-03 (58% of 371000 hectares of cotton cultivation in that year, as per the DCD sources she cites). This would mean only around 7% of the cotton land in the state was planted to non-GM (public sector) hybrids in 2009-10. **Given that Bt cotton expansion reached the halfway mark within cotton cultivation in the state only by 2008-09, even as hybrid seeds started replacing varietal tracts, how can some of the steep yield improvements between 2002-03 to 2007-08 be attributed to Bt cotton?**

COTTON YIELDS IN KARNATAKA OVER THE YEARS

Curiously enough, the picture of Area, Production and Yield of cotton in the state over the years has different numbers reported by two official sources: (a) Office of the Textile Commissioner, further cited by Cotton Corporation of India and (b) Directorate of Economics and Statistics, Ministry of Agriculture.



It is worth noting that even in 1992-93, yields were as high as 318 kilos per hectare in the state, while the latest year reported presents a yield figure of 346 kilos/ha, as per the Textile Commissioner's office.

SOME PAST STUDIES & REPORTSⁱⁱⁱ

The very first year of Bt Cotton cultivation in Karnataka showed up various problems that official monitoring records have captured. According to Commissioner for Agriculture, Karnataka, 5478 packets were cultivated by 4952 farmers across the districts of Belgaum, Bellary, Chitradurga, Bijapur, Davanagere, Dharwad, Haveri, Gadag, Gulbarga, Koppal and Raichur in the first year of Bt Cotton's official entry. There was a mixed picture with regard to yields with Bt Cotton, as per the monitoring report of the state government across different districts. In Bellary and Raichur, non-Bt Cotton yields were supposed to be higher while in Mysore, Davanagere and Haveri, Bt Cotton yields were reported to be higher. The variability of yields was considerable. It was observed that even in places where the yields were higher, the high cost of seeds had offset this profit (the cost of Bt Cotton was higher by 4.5 times than the non-Bt Cotton hybrids at that time). It was also reported that the market price for Bt Cotton was lower in almost all the districts (the Bt Cotton seeds supplied were of medium staple).

In a study of 100 early adopters of Bt cotton carried out in two districts of Karnataka during 2002, Orphal (2005) found that in irrigated cotton farmers using Bt had higher gross margins while the opposite was found under rainfed conditions^{iv}. The economic analysis showed that the economic advantage of Bt cotton depends on the agronomic conditions. While the gross margin for Bt was higher although not statistically significant if farmers had good access to irrigation, the opposite was true for cotton production under rain fed conditions. This study reports that pesticide costs were not the major cost item and the difference in seed cost between Bt and non-Bt was higher than the difference in pesticide cost. Hence, during years with low bollworm attack planting of Bt varieties can be a costly prophylactic pest control treatment that can reduce farmer's ability to cope with different pests later in the season.

Further, a survey in 2004 with the 100 early adopters supplemented by 50 non-adopters showed that about 90% of the early adopters had stopped growing Bt cotton, while continuing to cultivate cotton. An important factor was lack of irrigation facilities^{vi}. Most reasons given by the farmers relate to a lack of economic attractiveness. The category labeled 'other reasons' includes a number of farmers who stated that Bt is not used as it reduces soil health, is not suited for the prevailing soil conditions or due to deficits in knowledge and information on Bt cotton, amongst others, as per this study.

It has to be noted in this context that even in 2005-06, the percentage coverage under irrigation in total cotton area in Karnataka was just 14.7%, 14% in 2007-08 and was 13.8% in 1999-2000^{vii}. This became 20% in 2008.

In 2005, an official monitoring report of Bt Cotton in Karnataka recorded that yields of Bt Cotton in irrigated plots are better than rainfed crops. Further, the general trend that has been observed is that Bt Cotton varieties are highly sensitive to water logging and heavy rainfall.

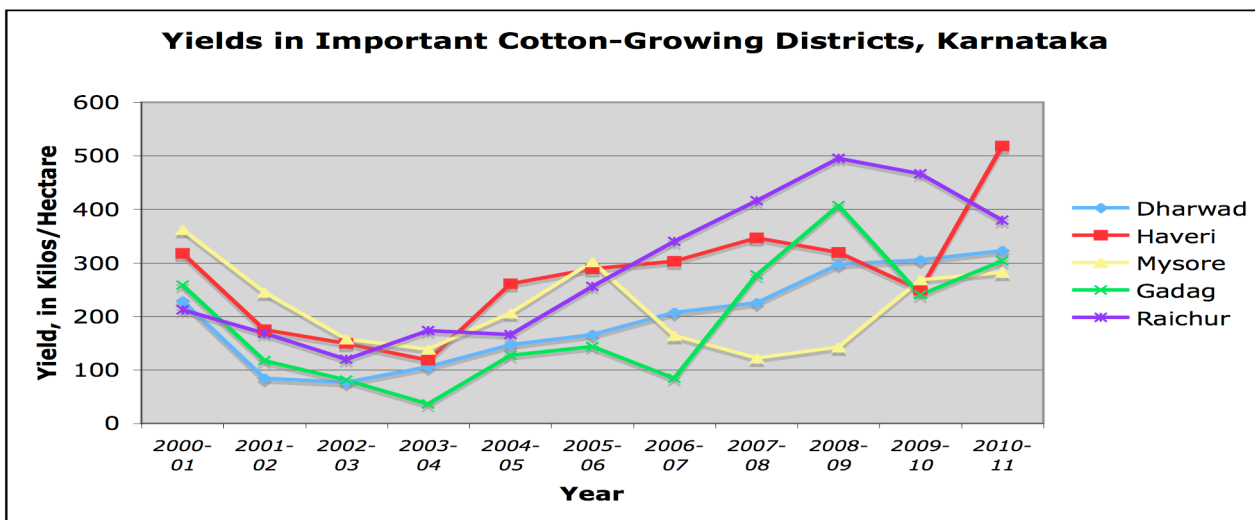
In an analytical piece based on data from various sources, Keya Acharya pointed out that in Karnataka, farmers reported middling yields and lesser revenue earnings from Bt than from non-Bt varieties till 2004^{viii}. In 2005, the State has shown good yields in both traditional and non-traditional cotton-growing belts but has earned lesser revenue from Bt than non-Bt varieties like DCH-32 and DHH-11. This was in spite of reduced use of pesticides in Bt fields and happened more due to demand of the long-stapled varieties existing within non-Bt varieties. But in 2005, at least one Bt long-stapled variety, MECH 6918 was introduced which has reported good results in Karnataka, making the economics of long-stapled Bt comparable to long-stapled non-Bt, she reported. Bt Cotton appears to favour 'rich' farmers, who have access to water, better resources and alternative support, says Acharya.

By the end of 2008, Bt. cotton had expanded to more than half of the total cotton area (this however indicates less rapid expansion in this state compared to some other cotton-growing states of the country). However, yield figures from the five largest cotton-growing districts of Karnataka, with their erratic pattern with regard to yields in the recent years, put a question mark on the claims of Bt Cotton proponents about yield increases due to Bt Cotton.

Yields of cotton crop in five top-cotton-growing districts of Karnataka

	Dharwad	Haveri	Mysore	Gadag	Raichur
2000-01	229	318	362	258	212
2001-02	84	175	245	117	168
2002-03	77	149	158	81	120
2003-04	106	118	139	36	173
2004-05	147	261	206	127	166
2005-06	166	289	302	144	256
2006-07	207	303	164	84	340
2007-08	225	347	122	277	416
2008-09	297	319	143	407	495
2009-10	305	249	268	240	466
2010-11	323	518	282	304	380

Source: Data obtained from the Directorate of Agriculture, Govt of Karnataka; data in Kg/Ha



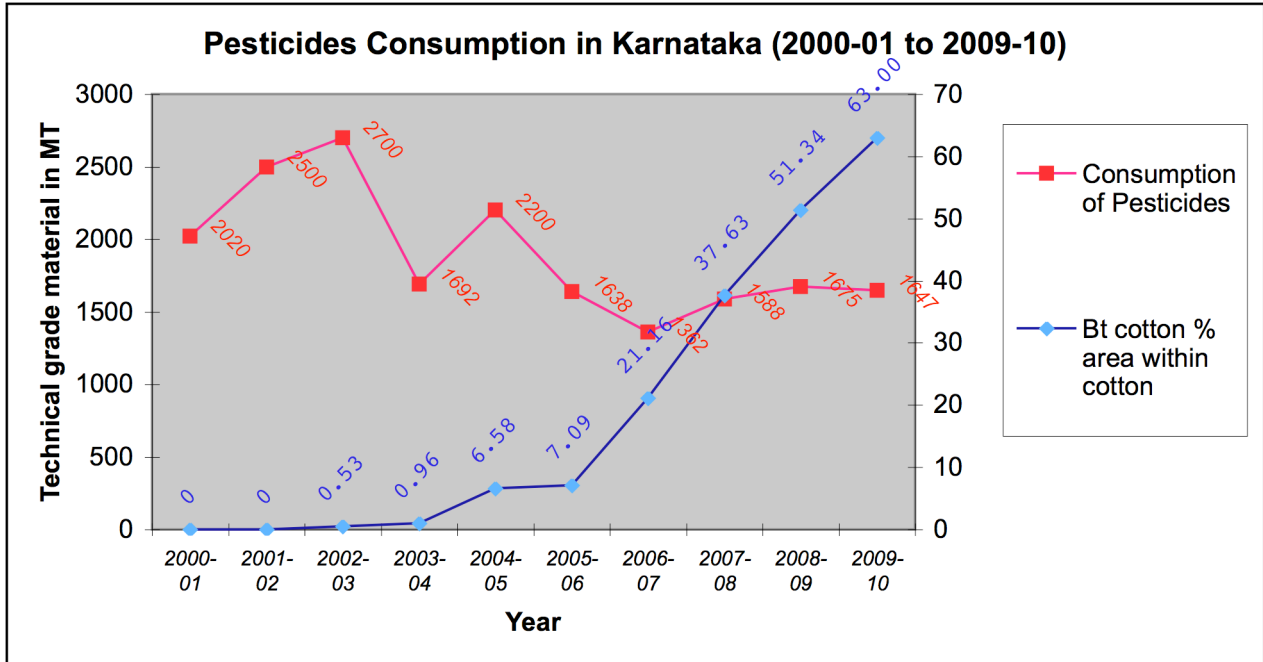
What is interesting to note with the top five cotton-growing districts in the state is the fluctuating yield figures, across the years even after the entry of Bt Cotton and the yields in several districts in the last year reported being around or below the yield levels in 2000. The variability of yields (kgs per hectare) across districts is also apparent from the table and graph above.

Meanwhile, a 2-year survey of performance of Bt Cotton hybrids in South India by Central Institute of Cotton Research ("Evaluation of Bt Cotton hybrids in South India" - Note sent by Mr Anupam Barik, Director, Kapas Vikas Nideshalaya, Directorate of Cotton Development, Govt of India, F. NO. D-3-14/09TMC/719, to Directors of Agriculture in Tamil Nadu, Andhra Pradesh and Karnataka on CICR's 2-year evaluation study on Bt Cotton hybrids on the basis of their yield performances in the South Zone) which brought out ground level data from Dharwad, Guntur and Coimbatore had the following results to share about Dharwad:

- The average lint yield (kgs per hectare) of 52 Bt Cotton hybrids in the zone was 526.79 kilos per hectare.
- The average lint yield of non-Bt cotton hybrids like DHH 11, Bunny etc., was 622 kilos per hectare.
- 44 of the Bt Cotton hybrids (out of 52) had lower yields than the average yield of non-Bt Cotton hybrids as per the findings here.

PESTICIDE/INSECTICIDE USAGE OVER THE YEARS

Here, we present data from the Ministry of Agriculture, Government of India, where the figures are slightly at variance with the NALMOT data (the NALMOT figures are supposed to be cotton specific while the MoA's figures cited below are for total pesticides consumption at the state level); however, charted against Bt cotton expansion in the state, the sudden increases and declines in pesticides consumption cannot be explained as correlated to Bt cotton and in the last 4 years, even as Bt cotton area has been expanding, there has only been an increase in pesticide consumption in the state.



Source: www.cibrc.nic.in/pestconsum.htm for data between 2000-01 to 2004-05, and www.ppgs.gov.in for data between 2005-06 and 2009-10

The National Level Monitoring Team's (NALMOT) report shows a pattern of increasing pesticide usage in Karnataka; what is important to note is that the usage of Insecticides in cotton is actually on the rise! This puts to question the very basis on which Bt Cotton was brought in.

Pesticides used in Cotton in Karnataka (Unit in metric tonnes)

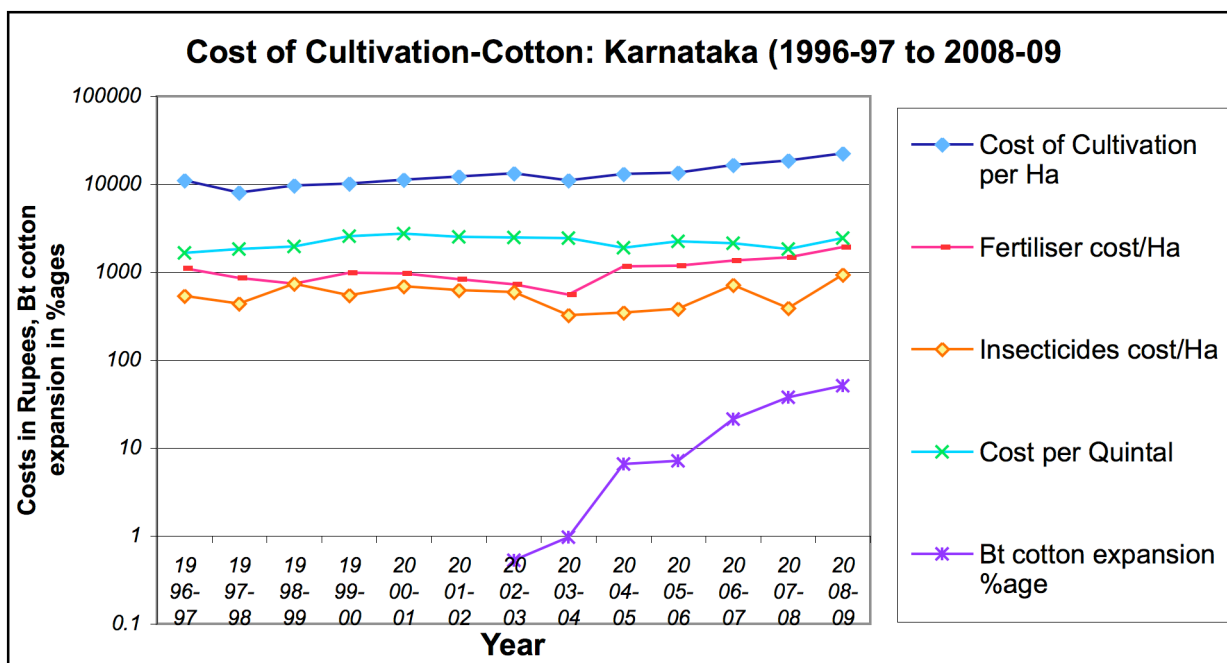
Sl. No.	Item	2005-06	2006-07	2007-08	2008-09	2009-10
1	Insecticides	1216	1008	1240	1406	1444
2	Fungicides	324	272	337	380	370
3	Others	998	82	108	114	8
	Total	1638	1362	1685	1900	1900*

Source: NALMOT report, 2008, obtained from the Directorate of Agriculture, Govt of Karnataka; * is projected demand for 2009-10; the above is for technical grade material

Further, studies show that the cotton mirid bug *Creontiades biseratense* (Distant) is an emerging insect pest on Bt cotton in Karnataka causing heavy shedding of squares and bolls which lead to significant reduction in seed cotton yield^x. Results of a systemic study undertaken during 2008-09 on the population level of the bug covering 7 districts, 22 taluks and 88 villages as well as other reports showed that the mirid bug, *C.biseratense* could be considered as an emerging threat to cotton cultivation in the state which is appearing regularly and damaging squares/bolls heavily. In 2010, a study was published by scientists from UAS-Raichur showing that bollworms survived Bt cotton hybrids (both single and double gene) in experimental plots of UAS Raichur^x.

COST OF CULTIVATION OF COTTON OVER THE YEARS

For this data, we turn to the Directorate of Economics and Statistics, Ministry of Agriculture, Government of India again. While we acknowledge that the Directorate does not provide details of cost separately for Bt and non-Bt cotton, given that a large scientific sample is reportedly used by the Directorate for collecting its cost data across different crops and regions, we believe that such data should at least be reflecting trends of claimed cost reduction due to expansion of Bt cotton in the cotton area of the country/Karnataka. Given below are cost per hectare, cost per quintal of cotton, fertiliser cost per hectare and insecticides cost per hectare for the state of Karnataka.



Source: Created from <http://eands.dacnet.nic.in/Cost of Cultivation.htm> data, accessed on 24/3/2012

The above graph clearly shows that expansion of Bt cotton has not brought down cost of cultivation at a per-hectare level or per quintal of cotton, including of specific inputs like insecticides. This data is being presented only in response to industry hype around Bt cotton's achievements, while expressly

acknowledging that single technologies that too controversial technologies like transgenics, cannot be magic bullets to complex phenomenon in Indian farming, including yields and costs.

ORGANIC COTTON IN KARNATAKA

Karnataka was one of the first states in the country to have announced an Organic Farming policy as the way forward for the farming sector in the state. However, a report by a German researcher (Nemes, 2010) clearly points out that seed security threats are looming large for the organic cotton cultivators in the state, as non-GM cotton seed production is coming down from both private and public sector players, while varietal tracts are vastly being replaced by hybrid seeds (with varieties, farmers would be in a position to save and re-use seed from their crop); this, despite the fact that the University of Agricultural Sciences in Dharwad is the largest repository of cotton germplasm diversity in the country. Further, there are several organic cotton projects in the state, increase in number and area over the years. Non-availability of appropriate seed material for organic cotton cultivation is a matter of serious concern to be noted and this has been brought up by organic farmers' groups in various fora as workshop reports and media coverage indicate, over the past few years.

KHARIF 2011 COMPARATIVE SURVEY: BT COTTON VIS-À-VIS NON-BT COTTON

A quick comparative survey was taken up with a small group of farmers in Raichur district of Karnataka in the month of March 2012, to understand the experiences with Bt cotton and non-Bt cotton farmers in Kharif 2011. The sample size from Raichur taluka of Raichur district is 15 Bt cotton farmers, compared with 15 non-Bt farmers.

Sample Farmers' Details, Raichur district:

Particular	Bt cotton farmers	Non Bt cotton farmers
Sample size	15 farmers, drawn from 2 villages: Poorthipli & Appanna Doddi	15 farmers, drawn from 2 villages: Baapooru and Gousnagar
Average area of cotton (Bt or organic) sown	2.16 acres	1.17 acres
Seed varieties/brands sown	Only one brand, supplied by the village-based dealer	1 non-Bt hybrid NHH-44 (9 farmers), 1 Bunny, 1 variety (1 farmer with Surabhi) and 4: unknown, loose seeds
Soil type in which cotton was sown	On Black Cotton: 14 farmers; Other soils (red, sandy etc.): 1	On Black Cotton: NIL farmers; Sandy: 11 farmers; Red: 4 farmers
Monocropping with cotton	3 out of 15	None
Landholding extent devoted to Cotton cultivation	32.5 acres out of 202 acres (16.1%)	17.5 acres out of 56.5 acres (31%)

Source: Primary Survey, 2012

SEED FOR COTTON CULTIVATION

Bt cotton farmers in the village surveyed in Raichur were seen to be falling back on one dealer to supply them with seed that he recommends. For non-Bt cotton seeds, our sample farmers even resorted to loose seed in the case of 5 farmers; in the case of one farmer, it was Surabhi, an extra long staple variety. In the case of several farmers, the origin of the seed could be F2 also.

Particular	Bt cotton farmers	Non-Bt cotton farmers
Seed quantity used, in packets, per acre	2 packets	1.03 packets (where the seed was purchased packaged)
Cost incurred on Seed, per acre	Rs. 1807.70	Rs. 440.00

The average per-acre cost incurred by Bt cotton farmers, when it comes to seed to be purchased from proprietary sources is nearly four times higher than non-Bt cotton farmers. It is also important to note that the sample did not have even one non-Bt cotton farmer who did not go in for other crops too, while in the case of Bt cotton, a higher degree of monocropped situation was noticed.

PLANT PROTECTION RELATED FINDINGS

All the farmers who took part in the survey were asked to share with the researchers information on their perception of pest and disease incidence in addition to data on number of pesticide sprays and cost incurred. The following are the findings.

Particular	Bt cotton farmers, in Raichur sample	Non Bt cotton farmers, in Raichur sample
Pest Incidence	Negligible: 0 farmers; Moderate: 9 farmers; High: 6 farmers NA: 0 farmer	Negligible: 0 farmers; Moderate: 6 farmers; High: 8 farmers NA: 1 farmer
Disease Incidence	Negligible: 0 farmers; Moderate: 6 farmers; High: 9 farmers; NA: 0 farmers	Negligible: 1 farmer; Moderate: 6 farmers; High: 7 farmers; NA: 1 farmer
Number of pesticide sprays	2.60 times	2.00 times
Range of pesticide sprays	0-2 times: 9 farmers; 3-4 times: 5 farmers; 6 sprays: 1 farmer	0-2 times: 11 farmers; 3-4 times: 4 farmers
Avg Cost of pesticides per acre	Rs. 703.30	Rs. 463.33

The cost incurred on pesticides per acre is 52% higher on Bt cotton compared to non-Bt cotton, belying claims on pesticide usage in Bt cotton. It is worth noting that in Raichur Bt cotton sample, 40% of the farmers went in for 3 or more sprays, whereas in the non-Bt cotton sample, only 27% went in for this range of spraying. On the other hand, a majority of Bt cotton farmers reported moderate pest incidence, even as a large chunk of farmers in the non-Bt cotton sample reported High pest incidence, even as Bt cotton farmers resorted to 30% more number of sprays compared to non-Bt cotton farmers in Raichur.

EXPENSES ON SOIL PRODUCTIVITY MANAGEMENT

When it comes to **Chemical Fertilisers** use, **Bt cotton farmers used 117 kilos of chemical fertilisers per acre on an average, whereas non-Bt cotton farmers used only 88.33 kilos per acre on an average (this is 32.5% more usage in quantity in Bt cotton fields, compared to non-Bt cotton).**

YIELD AND NET INCOME COMPARISON

Particular	Bt cotton farmers	Non-Bt cotton farmers
Average Yield per acre, in quintals	1.86	1.05
Average Price per quintal	Rs. 3827.00	Rs. 2869.23 (due to some tie-up with some procurement company)
Gross Income per acre	Rs. 7118.22	Rs. 3012.69
Cost of cultivation per acre	Rs. 8740.00	Rs. 5572
Net Income per acre	(-) Rs. 1621.78	(-) Rs. 2559.31 or (-) Rs. 1553.65 if market price was uniform

In Raichur, the yields of Bt cotton farmers as well as non-Bt cotton farmers are quite low. The farmers blamed it on late and no rains. However, cost of cultivation in Bt cotton is quite high (57% higher than in non-Bt cotton) and given that the non-Bt farmers had ended up selling their produce to a procurement company through a prior arrangement, they obtained lower prices than the Bt cotton farmers (nearly thousand rupees difference per quintal). The low yield coupled with vastly lower prices in the market for the non-Bt cotton producers meant that their net returns at the end of the season were negative! IN the case of Bt cotton farmers too, because of low yields and higher cost of cultivation, the net returns were negative. If the price obtained by Bt cotton farmers was imputed to the non-Bt cotton farmers who were forced to sell at a given lower price, this survey shows greater negative net returns with Bt cotton than with non-Bt cotton. Meanwhile, the yields of non-Bt cotton can be addressed probably by ensuring good source of seed supply

and if practices like NPM and organic farming are taken to the farmers, the cost of cultivation will come down drastically even as productivity improves^{xi}.

It is obvious from the above cost figures that any failure of Bt cotton would mean a greater risk for farmers than the riskiness present in non-Bt cotton.

OTHER ISSUES WITH BT COTTON CULTIVATION

The current survey asked all the 15 Bt cotton farmers for their feedback/perceptions on impacts of Bt cotton on human health, animal health and soil health even as the same questions were asked non-Bt cotton growers too and the following is the response.

(a) 10 of the 15 Bt cotton farmers surveyed in Raichur district too reported that some health effects like skin rashes and itching have been observed in Bt cotton fields during harvest time only. This was not reported by the non-Bt cotton farmers.

(b) None of the Raichur Bt cotton or non-Bt cotton farmers had anything to report about livestock impacts from their cotton cultivation.

(c) 7 of the Bt cotton farmers felt that the bollworm is indeed growing resistant to Bt cotton that they grow. Once again, this is 50% of the farmers and it has to be remembered that Bt cotton made an entry into this area only in the past 4 years or so.

(d) All the 15 farmers in the Bt cotton sample, reported that they are noticing adverse soil health impacts with Bt cotton. They stated this in the context of yields of subsequent crop on the land being affected.

To sum up.....

1. Claims made in support of Bt Cotton in terms of pesticide usage do not hold as the data presented from official records, as well as our own comparative data between Bt cotton and non-Bt cotton shows. Insecticide usage in Karnataka in cotton crop has actually increased as per the official NALMOT data. This belies the rationale for bringing in Bt Cotton.
2. Secondary literature shows that Bt Cotton was working well only in irrigated conditions whereas a majority of cotton cultivation in Karnataka is in unirrigated conditions.
3. Government of India's data on cost of cultivation of cotton shows no claimed reductions on account of Bt cotton, over the years that Bt cotton area has expanded within the cotton cultivation area of the state. Moreover, our primary survey shows that Bt cotton cultivation is substantially more expensive than non-Bt cotton cultivation and it is in any case manifold costlier than organic cotton cultivation.
4. Chemical fertiliser usage in Bt cotton when compared to non-Bt cotton was higher by 32.5% in Raichur (and if compared to organic cotton cultivation, completely additional). This has its own economic and environmental implications.
5. From around 58% of cotton varietal area in the state in 2002-03, the area under various cotton varieties decreased to 30% in 2009-10 (and some more subsequently) and only 7% of the cotton land was under non-GM hybrids in that year. Given that Bt cotton expansion reached the halfway mark in the cotton extent of the state only by 2008-09, even as hybrid seeds replaced varieties, how can some of the steep yield improvements between 2002-03 to 2007-08 be attributed to Bt cotton?
6. In the top five cotton growing districts of Karnataka, the picture with yields is that of dramatic fluctuations and variability across years and districts. Other data on various Bt Cotton hybrids right now in the market from CICR shows that non-Bt Cotton's average lint yield is higher than the average of the Bt Cotton hybrids studied. At the state level, high cotton yield years existed in the pre-Bt cotton years too (318 kgs/Ha twenty years ago in 1992-93, compared to 346 kgs/Ha in last year reported 2010-11); further, different sources of information present different figures. Further, citing only the increase from 143 kgs/ha in 2002-03 to 276 in 2007-08 in a steep-increase period ignores the high yield of 263 kgs/Ha achieved in the pre-Bt cotton year of 2000-01!
7. Our own primary survey shows that yields in both Bt cotton and non-Bt cotton are dismally low, pushing farmers into a situation of negative net returns (in the case of non-Bt cotton, it is not clear if it is F2 or F1 hybrid that the farmers had used where several had used loose seed). **This clearly puts a question mark on cotton itself being a sustainable livelihood source for farmers here, even as the risks with higher-investment crops like Bt cotton are apparent.**
8. Bt cotton farmers reported observations on health effects of working in Bt cotton fields, in addition to soil health impacts. Nearly half of the Bt cotton farmers also reported that bollworm resistance is being observed by them.
9. It is apparent that a seed crisis is brewing when it comes non-GM cotton seed supply and organic cotton farmers are suffering due to lack of choices in the market and due to lack of supply from other sources too (including public sector). This needs to be addressed immediately.

We conclude this report by pointing out, using secondary and primary data that the false hype and failed promises of Bt cotton have been exposed, at the end of ten years of approved Bt cotton cultivation in India.

This experience has valuable lessons to be learnt, including on the regulatory front, which should bring in abundant caution before further investments are made on other GMOs in our agriculture. It is clear that non-GM and organic cotton farmers have very little choice in terms of good quality seed material being supplied to them. There is a serious concern around loss of diversity and suitable cultivars. It falls upon the

public sector to revive these, so that farmers can take up low-external-input, low-risk agriculture. It becomes important that seed breeding focuses on developing seed in farmers' growing conditions (and organic conditions) rather than be responsive to external chemical inputs alone.

Meanwhile, experience with organic farming shows that net incomes of farmers can be enhanced and sustained without concomitant economic or environmental crises through this approach. It is time that alternatives are given full support and promoted aggressively by the government, even as corporations are strictly regulated for liability around claims and promises from their side, since the gambling around cotton farming has become a matter of life and death for many of India's farmers.

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