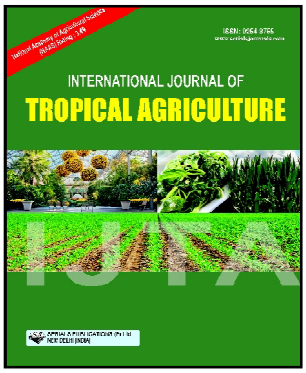

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Socio Economic Impact of GM Crop: *Case Study of Bt Cotton in Vidharbha, Maharashtra*

Tafeem Uddin Siddiqui*

* *Research Scholar, Centre for Studies in Science Policy, School of Social Sciences, Jawaharlal Nehru University, New Delhi-110067*
E-mail: tafeemsiddiqui@gmail.com

Abstract: This paper presents the results of a study aimed at measuring the economic performance of Bt cotton and consequent perceived social benefits if any, accrued for the technology adopters. It is the first study of its kind in India in that the data have been collected from farmers growing the crop under market conditions, rather than from trials after almost a decade of the introduction of technology. The research compares the performance of Bt and non-Bt cotton farm plots in Maharashtra over the 2012 and 2014 growing seasons. Results show that Bt cotton varieties have had a significant positive impact on average yields and on the economic performance of cotton growers there by improving the socio-economic conditions of the farmers – second order impact. The evidence and results alludes to a clear economic advantage in growing Bt cotton compared to non-Bt. An increased investment in education, housing and other assets can only be seen as a positive development in Vidharba. The empirical analysis elucidates that Bt is nowhere only responsible or the soul trigger of farmer's suicide, there are multiple parameters that derive the farmers towards the brink of suicide. Further Bt cotton is not a magic bullet to address various problems farmers; it can make/offer a contribution or it can be a part of the overall solution package for farm economy. Subsequently I would like to stress that Bt cotton or Bt technology is just a cog in the wheel or we can say it's a component of the larger ecosystem which can only be beneficial to the farming or the agrarian community only and only if all the supporting system and parameters of the ecosystem are in order.

Keywords: Bt Cotton, India, Vidharba, GM crops, farmer suicide.

THE SIGNIFICANCE OF GENETICALLY MODIFIED (GM)[1] TECHNOLOGY

The introduction and spread of genetically modified (GM) crops is one of the more significant technological changes currently taking places in the world. The transgenic[2] crops were commercialized in 1996 in the world and in 2002 in India. While the potentials of this technology are still debated, farmers' demand for GM seeds has continued to grow rapidly.

Despite widespread adoption of genetically modified (GM) crops in many countries[3] controversies about their advantages and disadvantages continue. In the public debate, negative attitudes often seem to dominate. Civil society groups tend to emphasize potential risks of GM crops and question reports about positive agronomic and economic effects[4,5,6]. Especially with a view to developing countries, there are widespread concerns that GM crops fail to benefit smallholder farmers and contribute to social and economic hardship[7]. Much of this debate focuses on Bt cotton[8,9,10,11], as this is currently the most widely used GM crop technology among smallholders. Using comprehensive data from India, we show that these concerns about negative social and economic impacts are not backed by representative empirical evidence.

This paper is an attempt to explain socio economic impact of genetically (GM) modified cotton – in background of famer's suicide and agrarian crisis with a case study of Maharashtra state, particularly Vidharba region. In the wake of several suicides reports emanating from the region, this study becomes more critical and timely. The point to emphasize is that mass suicides associated with the agricultural crisis have been reported in Vidharba since 1986[12], but the NGO's, few interest group & a section civil society are directly connecting this genocide or suicide to the use and impact of Bt cotton or the GM technology.

Here in my study the economic impact analysis concentrates on farm income effects because this is a primary driver of adoption amongst farmers (both large commercial and small-scale subsistence). The study will be more realistic as the data will been collected from farmers growing the crop under market conditions, rather than from trials. The research compares the performance of more than 30 Bt and non-Bt cotton farm plots in Vidharba region over the 20012-13 growing seasons. Special attention is given to the analysis of Bt cotton employment and labor market impacts and related income effects for farm and non-farm households and opportunity income.

OBJECTIVES OF THE STUDY

The current study also intends to understand how public conceptualize and responds to the plant bio-technology as:

- To study the impact of Bt cotton on the agro economic cost yield revenue at the farm level.
- To analyze the labor impact of Bt cotton
- To assess the impacts of Bt cotton on farmers livelihoods, including suicides if any?
- To study the diffusion of Bt cotton particularly with regards to regulatory framework
- To study second order impact of Bt cotton in terms of socio economic mobility, status, achievement and economic power within the region.

METHODOLOGY STRUCTURE

In the current study, research methodology would be both qualitative as well as quantitative in nature. The below diagram Fig. 1 gives a diagrammatic view of the methodology used:

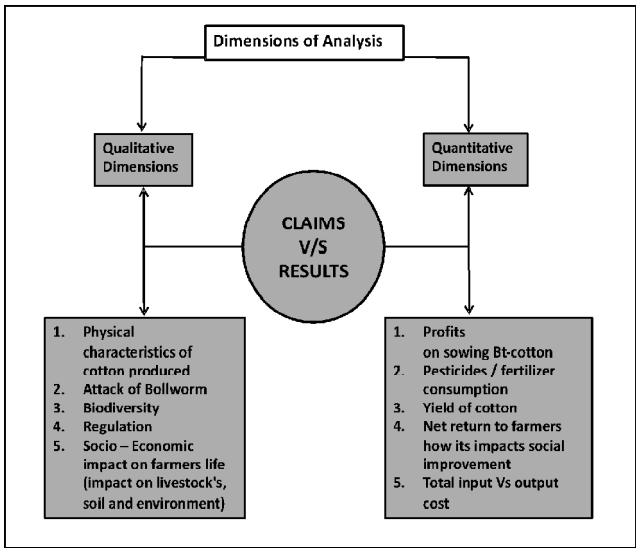

Figure 1: Model for Methodology Adopted

Source: Compiled by the Author

PROPOSED SAMPLE DESIGN

Maharashtra having the third largest are of 307,690 km2 in the nation and a population of almost 79 million; the state adds some 23% of the nation's industrial productivity. Cotton farming is a dominant economy in Maharashtra, specially Vidharba which is known as the cotton belt with 2 foremost districts; Amravati and Wardha, I have chosen my sample from these districts (Maharashtra being the state with huge dependency on cotton for agricultural economy, and further Vidharba the real bone of contention and debate, specially the two major zones, Amravati & Wardha) as depicted in Fig. 2.

An additional key rationale for selecting these districts is that, farmers in these districts are seen to have shown greater enthusiasm to experiment with

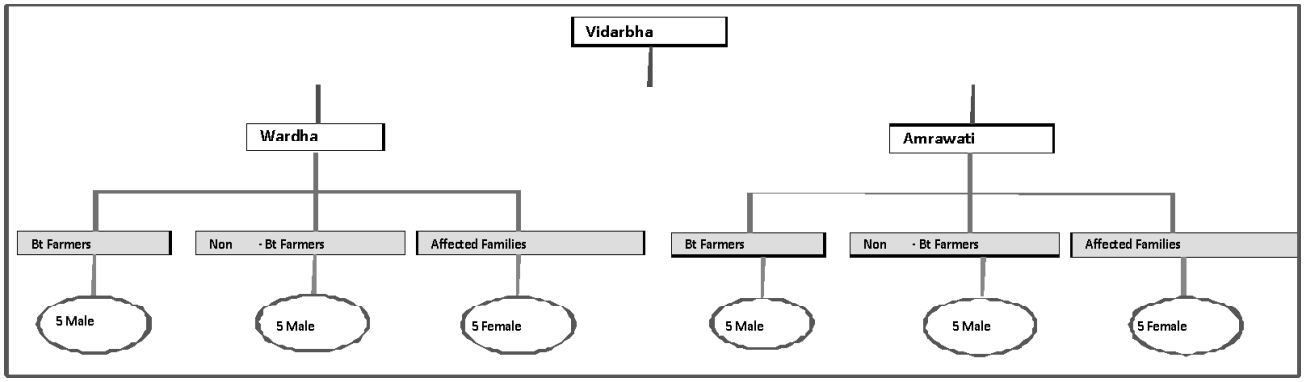

Figure 2: Sample Design Diagram for Selection of Farmers

Source: Compiled by the Author

novel technologies vis-à-vis seeds, irrigation, mechanization, etc. Thus dominant cotton growing villages in these districts became the core geographical domain of our sample of respondents..

The above diagram depicts our planning of a sample design used in methodology for two district i.e. Wardha & Amravati. A sample of 15 farmers was to be selected from each of the two districts. Out of these 15 from each district; 5 Bt, 5 Non Bt & 5 families of farmers who have committed suicide were taken from each district respectively. From each district I collected data on 5 farmers growing Bt-cotton, 5 farmers growing non Bt cotton & 5 families of farmers who have committed suicide and are growing Bt cotton, so overall it was 30 farmers from both the districts. Data was collected for year 2012 and 2014.

METHODOLOGY OF EMPIRICAL ANALYSIS

Primary data has been generated based on:

- Interviews of farmers and women in their households;

- Focused group discussions with women and men's groups in the identified villages;
- Information gathered from sending questionnaires to agro-scientists, marketing agencies, government agencies regional NGOs, civil society organizations including farmers organization and technocrats who support against the use of genetically modified technology in the area of agriculture; and
- Testimonies of activists, thinkers from the Vidharba region who influence the direction of policies.

PLANNED MODEL DESIGN

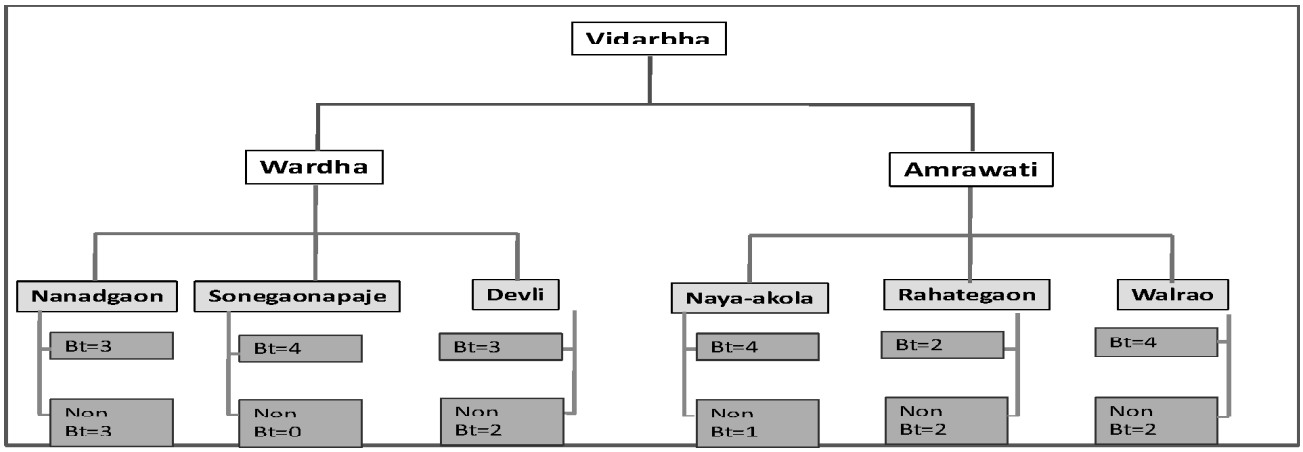

Figure 3: Diagram Showing Sample Design For Farmers Identification for Survey

Source: Compiled by the Author

The above Fig 3 depicts our planning of a sample design across 2 districts. A sample of 30 farmers was to be selected from 2 districts (Wardha & Amravati). From each district we had to collect data of 15 farmers, 5 Bt, 5 non Bt & 5 affected families[13] in the cotton area respectively. So, here if we look at the above diagram it is reflected that in both districts, namely Amravati & Wardha; for farmer's interview, focus group discussion & feedback of the village panchayat three villages were selected from each district, they are: Nanadgaon, Sonegaonapaje & Devli from Wardha and Naya-akola, Walrao & Rahategaon; from Amravati district. It was found that in each village the percentage of non Bt cotton farmers was less than even 5%. They have become a truly rare species, and the one who are doing the farming for non Bt is that they feel loyal to it as their forefathers have been practicing it and the new technology as they heard from various NGO's might night be suitable for their land for their future generation to come.

Table 4.1
The table shows that data has been collected across 30 households

District	*Bt*	*Non-Bt*	*Small*	*Medium*	*Large*
Wardha (Sonegaon,	5	3	3	3	1
Devli & Nanadgaon)	5	2	3	3	1
Sub-Total	10	5	6	6	2
Amravati (Nayaakola,	5	3	3	3	2
Walrao & Rahategaon)	5	2	3	4	1
Total	10	5	6	7	3
Grand Total	20	10	12	13	5

Source: Compiled by the Author

Questionnaire[14]

THE REAL DETERMINANTS: INPUT USE AND COST OF CULTIVATION

In this section, we examine the input use pattern under Bt and Non-Bt cotton. This has been examined by farm size under irrigated and unirrigated conditions. The total cost of cultivation per hectare, including the marketing cost, was respectively Rs 43420 for Bt cotton and Rs 36915 for non Bt cotton under irrigated conditions. The corresponding figures under the unirrigated conditions were respectively Rs 40825 and Rs 33132. Thus the total cost of cultivation of Bt cotton was about 20 percent higher compared to non Bt cotton irrespective of the irrigation status. There was marked difference in the cost of production per hectare under different farm size. The cost of production per hectare has been comparatively high for large size farmers for both Bt and non Bt Cotton. This can be mainly attributed to higher doses of fertilizer use, greater cost of irrigation, and high levels of human labor use, particularly for cotton harvesting. The cost shares given in table below would be useful to understand this better.

SHARE OF VARIOUS INPUTS IN TOTAL COST OF PRODUCTION

As can be seen from **Table 1 & 2** Cost of seed accounted for on around 8 to 10 percent of the cost of cultivation for Bt cotton, whereas this was around 2 to 4 percent for non bt cotton. The relative share of various inputs in the cost of cultivation of Bt cotton in descending order of their shares are: fertilizer with around 38.37 percent human labor with 27.8 percent, pesticides with 8.9 percent, seed at 8.8 percent, and bullock labor with 5.27 percent. For non bt cotton they were: human labor with 27 per percent, pesticides with 24, fertilizer with 33.24 percent, bullock labour with 7 percent and seed with 2.70 percent. It is interesting to notice that the share of seed and pesticides cost together account for about 20 per cent of the cost equally for both Bt and Non Bt cotton farmers. The share of human labor and fertilizer in total cost of cultivation were higher under medium and large size farms compared to small farms. The shares of the various costs are also compared in the Figures below.

Table 1
Cost of Production of Bt and Non Bt Cotton among Sample Farmer Households per Hectare in Rupees for Year 2012 –2013

	Bt Cotton			*Non Bt Cotton*		
	I	*UI*	*Total*	*I*	*UI*	*Total*
			Small			
1. Seed	3487	3600	3650	1000	1150	1050
2. Human Labour	9000	9500	9250	7500	8200	8005
3. Bullock Labour	2500	1900	2280	2500	2200	2450
4. Tractor	1400	1450	1430	900	950	930
5. Fertilizer	15750	14250	15300	10000	9500	9300
6. Pesticides	3000	3500	3400	8000	8500	8200
7. Irrigation	2000	0.00	1150	1800	0.00	700
8. Other Operational Costs	500	600	540	100	120	110
9. Total operational Cost	37637	34800	37000	31800	30620	30745
10. Total Marketing Cost	900	1250	1050	1000	1300	1260
Total Cost	38537	36050	38050	32800	31920	32005

		Bt Cotton			*Non Bt Cotton*		
		I	*UI*	*Total*	*I*	*UI*	*Total*
				Medium			
1.	Seed	3600	3750	3250	980	1000	990
2.	Human Labour	10000	11500	10800	8000	8200	8130
3.	Bullock Labour	2000	2300	2150	2500	2200	2390
4.	Tractor	1800	1950	1840	1950	800	1180
5.	Fertilizer	18000	16900	17050	14000	12800	13200
6.	Pesticides	3450	3950	3850	8000	8500	8600
7.	Irrigation	2600	0.00	1280	2400	0.00	780
8.	Other Operational Costs	700	790	744	700	200	440
9.	Total operational Cost	42150	41140	40964	38530	33700	35710
10.	Total Marketing Cost	1700	1800	1780	1300	1900	1590
	Total Cost	43850	42940	42744	39830	35600	37300
				Large			
1.	Seed	3750	3800	3790	950	1000	980
2.	Human Labour	14000	13500	13900	11000	10000	10500
3.	Bullock Labour	2200	1900	2090	2400	1700	2050
4.	Tractor	1100	1050	1080	850	900	880
5.	Fertilizer	20000	18500	19000	16400	14200	15900
6.	Pesticides	4100	4500	4390	6500	7000	6580
7.	Irrigation	2800	0.00	1440	2250	0.00	490
8.	Other Operational Costs	800	750	780	950	200	710
9.	Total operational Cost	48750	44000	46470	41300	35000	38090
10.	Total Marketing Cost	1650	1550	1590	1000	700	880
	Total Cost	50400	45550	48060	42300	35700	38970
				Overall			
1.	Seed	3650	3790	3710	920	950	935
2.	Human Labour	11250	11300	11270	8350	8650	8450
3.	Bullock Labour	2320	2190	2210	2450	2090	2250
4.	Tractor	1490	1780	1680	1210	1350	1250
5.	Fertilizer	16800	15900	16100	12200	10500	11500
6.	Pesticides	3550	3690	3601	7900	8100	8000
7.	Irrigation	2280	0.00	1220	2190	0.00	610
8.	Other Operational Costs	670	695	685	595	172	390
9.	Total operational Cost	42010	39345	40476	35815	31812	33385
10.	Total Marketing Cost	1410	1480	1475	1100	1320	1210
	Total Cost	43420	40825	41951	36915	33132	34595

Source: Compiled by the Author

Table 2
Percentage Share of Various Input Costs in the Total Costs of Production

	Bt Cotton			*Non Bt Cotton*		
	I	*UI*	*Total*	*I*	*UI*	*Total*
			Small			
1. Seed	9.04	9.972	9.56	3.00	3.45	3.2
2. Human Labour	23.31	26.315	24.235	22.5	24.63	25.01
3. Bullock Labour	6.475	5.263	5.973	7.5	6.61	7.65
4. Tractor	3.62	4.016	3.746	2.76	2.85	2.90
5. Fertilizer	40.79	39.47	40.08	30	28.54	29.05
6. Pesticides	7.77	9.69	8.90	24	25.59	25.62
7. Irrigation	5.18	0.00	3.01	5.43	0.00	2.18
8. Other Operational Costs	1.29	1.66	1.41	0.31	0.36	0.34
9. Total operational Cost	97.45	96.596	96.94	95.43	96.06	96.06
10. Total Marketing Cost	2.61	3.462	2.75	3.6	3.9	3.936
Total Cost	100	100	100	100	100	100
			Medium			
1. Seed	8.20	8.733	7.60	2.46	2.8	2.65
2. Human Labour	22.80	26.78	25.26	20.80	23.03	21.796
3. Bullock Labour	4.56	5.35	5.02	6.27	6.179	6.40
4. Tractor	4.10	4.54	4.30	4.89	2.247	3.16
5. Fertilizer	41.04	39.35	39.88	35.14	35.95	35.83
6. Pesticides	7.86	9.198	9.00	20.08	23.87	23.956
7. Irrigation	5.93	0.00	2.99	6.025	0.00	2.09
8. Other Operational Costs	1.60	1.83	1.74	1.75	0.56	1.17
9. Total operational Cost	96.123	95.80	95.83	96.736	94.66	95.737
10. Total Marketing Cost	3.88	4.19	4.26	3.36	5.43	4.262
Total Cost	100	100	100	100	100	100
			Large			
1. Seed	7.44	8.34	7.88	2.24	2.8	2.51
2. Human Labour	27.77	29.63	28.92	26.004	28.01	26.94
3. Bullock Labour	4.36	4.17	4.34	5.67	4.76	5.260
4. Tractor	2.18	2.30	2.247	2.01	2.52	2.258
5. Fertilizer	39.68	40.61	39.53	38.72	39.97	40.08
6. Pesticides	8.13	9.87	9.13	15.366	19.60	16.88
7. Irrigation	5.555	0.00	2.99	5.51	0.00	1.257
8. Other Operational Costs	1.58	1.646	1.622	2.24	0.56	1.82
9. Total operational Cost	96.726	96.597	96.69	97.64	98.13	97.74
10. Total Marketing Cost	3.37	3.58	3.40	2.43	1.96	2.36
Total Cost	100	100	100	100	100	100

				Overall			
1.	Seed	8.40	9.28	8.84	2.49	2.9	2.70
2.	Human Labour	25.90	27.67	26.86	22.62	26.10	24.40
3.	Bullock Labour	5.34	5.36	5.27	6.64	6.31	6.50
4.	Tractor	3.43	4.36	4.01	3.28	4.07	3.61
5.	Fertilizer	38.69	38.95	38.37	33.04	31.69	33.24
6.	Pesticides	8.17	9.03	8.58	21.40	24.44	23.12
7.	Irrigation	5.25	0.00	2.91	5.932	0.00	1.76
8.	Other Operational Costs	1.54	1.70	1.633	1.61	0.52	1.13
9.	Total operational Cost	96.75	96.4	96.48	97.02	96.00	96.50
10.	Total Marketing Cost	3.25	3.7	3.52	2.980	4.00	3.50
	Total Cost	100	100	100	100	100	100

Source: Compiled by the Author

COTTON PICKINGS, YIELDS AND VALUE OF OUTPUT

Most sample farmers, over 90 percent, report at least five cotton fiber pickings and the rest had up to 6 pickings; the average yield per picking under Bt cotton was invariably higher as reported per **Table 3** from survey of farmers. However, the percentage distribution pattern of quantity of cotton realized under each picking did not differ much for both Bt and Non Bt cotton. Thus, there is not much difference between Bt and Non Bt in the number of pickings or the distribution across pickings. The main difference is the quantity obtained in each picking especially from the second picking onwards.

Table 3
Yield per hectare in Kilogram per Picking among Bt and Non Bt Cotton Farmer Households

	Pickings						
	First	*Second*	*Third*	*Fourth*	*Fifth*	*Sixth*	*Total*
			Bt Cotton				
			Small				
Irrigated	260	530	700	580	210	175	2455
Un irrigated	340	630	535	410	200	45	2160
Total	310	590	585	535	205	115	2340
			Medium				
Irrigated	315	760	730	480	310	80	2675
Un irrigated	450	690	630	415	230	30	2445
Total	365	730	690	450	278	65	2578
			Large				
Irrigated	330	700	810	620	345	60	2865
Un irrigated	350	660	780	475	221	25	2511
Total	340	685	790	560	290	48	2713

contd. table 3

	Pickings						
	First	*Second*	*Third*	*Fourth*	*Fifth*	*Sixth*	*Total*
			Overall				
Irrigated	310	695	770	575	315	95	2760
Un irrigated	370	660	680	440	215	30	2395
Total	335	670	730	515	270	65	2585
			Non Bt Cotton				
			Small				
Irrigated	345	470	490	340	175	25	1845
Un irrigated	260	430	355	320	185	18	1700
Total	301	450	410	335	180	20	1790
			Medium				
Irrigated	240	370	490	482	128	25	1735
Un irrigated	205	470	530	320	180	25	1730
Total	210	445	520	360	165	25	1725
			Large				
Irrigated	280	550	540	400	155	20	1945
Un irrigated	180	480	560	390	210	30	1850
Total	205	490	550	395	190	25	1855
			Overall				
Irrigated	300	470	500	390	150	25	1835
Un irrigated	210	460	495	350	190	25	1730
Total	260	460	495	370	185	25	1795

Source: Compiled by the Author

The **Table 4** undoubtedly provides the best way of comparison & a summary comparison of the performance of Bt and Non Bt cotton in terms of their yield and value of output under irrigated and unirrigated conditions. The table shows that in all cases, the yields of Bt cotton are higher than the yields of Non Bt cotton. This is found to be true under irrigated as well as unirrigated conditions. The yields obtained with irrigations are typically higher than those without irrigations. The results indicated a sizeable impact of Bt cotton on the yield and value of output under both irrigated and unirrigated conditions.

Table 4
The Yield and value of output from Bt and Non Bt Cotton

	Bt Cotton			*Non Bt Cotton*		
	Irrigated	*Un Irrigated*	*Total*	*Irrigated*	*Un Irrigated*	*Total*
Yield (Kg/Ha)	2760	2395	2585	1835	1730	1795
Value of output (Rs.) @ 40 Rs/Kg	110400	95800	103400	73400	69200	71800

Source: Compiled by the Author

VALUE OF OUTPUT AND NET PROFIT

The **Table 5** below gives the findings on the value of production, cost of production, and net profit per hectare for Bt and Non Bt farmer households. The net profit per hectare under bt cotton was Rs 66980 under irrigated and Rs 54975 under un irrigated conditions. The net profit per hectare under Non Bt cotton was Rs 36485 under irrigated and Rs 36068 under unirrigated. Thus, both under irrigated and unirrigated conditions the net profits are found to be substantially higher with Bt cotton. There is some positive association with the farm size but even small farmers are able to realize substantial gains in net profits. In percentage terms, under Bt cotton as compared to non Bt cotton for all sample farmers together, the total cost of production of Bt cotton was higher by around 18 percent under irrigated and 22.22 percent under unirrigated conditions. The value of output of Bt cotton was higher by 50.4 percent under irrigated area and 38.44 percent under unirrigated area. The net profit of Bt cotton under irrigated and unirrigated area as compared to those under non Bt cotton was 83 percent and 52 percent higher respectively. Thus, even though the cost of production is higher with Bt cotton, the value of production, and net profits are substantially higher in Bt cotton as compared to non Bt.

The results indicate that Bt even by itself has a positive impact on the yield. The impacts of fertilizers and human labor are also positive. Although the cost of pesticides and farm power are positive associated, but they are statistically non significant. These results remain similar for the value of output. While the cost of pesticides has a strong

Table 5
Economics of Bt Cotton over Non Bt Cotton among Sample Farmer Households
(Rupees per Hectare)

	Bt Cotton			*Non Bt Cotton*			*Bt over Non Bt Cotton (%)*		
	I	*UI*	*Total*	*I*	*UI*	*Total*	*I*	*UI*	*Total*
				Small					
Total Cost	38537	36050	38050	32800	31920	32005	17.5	12.94	18.89
Value of Output	98200	86400	93600	73800	68000	71600	33.06	37.76	37.97
Net Profit	59663	50350	55550	41000	36080	39595	45.52	39.56	40.30
				Medium					
Total Cost	43850	42940	42744	39830	35600	37300	10.09	20.62	14.56
Value of Output	107000	97800	103120	69400	69200	69000	54.17	41.32	49.45
Net Profit	63150	54860	60376	29570	33600	31700	113.56	63.27	90.46
				Large					
Total Cost	50400	45550	49770	42300	35700	38970	19.15	27.95	27.7
Value of Output	114600	100440	108520	77800	74000	74200	47.30	35.73	46.25
Net Profit	109560	54890	58750	35500	38300	35230	208.6	43.32	66.76
				Overall					
Total Cost	43420	40825	41951	36915	33132	34595	17.62	23.22	21.26
Value of Output	110400	95800	103400	73400	69200	71800	50.41	38.44	44.01
Net Profit	66980	54975	61449	36485	36068	37205	83.58	52.42	65.16

Source: Compiled by the Author

and negative influence in determining the profit levels, fertilizer and Bt variety have a strong and positive influence. The overall results based on the linear and statistical model are very similar – both confirm the statistically significant and positive association of Bt cotton with the yield, revenue and profits in cotton & eventually technology is highly profitable.

DISCUSSION AND CONCLUSION

From the observations, qualitative, quantitative and few other studies mentioned in the tables and from field research, some interesting points emerge. The evidence and results does unanimously point to a clear economic advantage in growing Bt cotton compared to non-Bt. In the seasons and geography where comparisons were possible the various studies, using quite different methodologies and statistical tools, point to this advantage. It has been observed clearly that the increase in gross margin is a result of higher yields rather than lower costs. Plant resistance, be it based on GM or not, is efficient in the sense that there is less dependence upon farmers making the right decisions over what, how and when to spray. The technology lessons the chance of error.

To delve into deeper socio economic impact of the Bt cotton farmers one of the other 'good news' dimension to the Bt story is the use to which farmers claim to make of the additional income. Top of the list is clearly investment in their children's education. This is followed by greater than before venture in cotton, other crops and the repayment of debt. Additional Investment in non-cotton crops would help to diversify livelihoods, as per the farmers view. It was also found that there is less emphasis on investment in physical assets but there is evidence that farmers are investing in more land and structures such as houses. An increased investment in education can only be seen as a positive development in Vidharba, and is borne out by data which clearly points towards the increase in the no of family members receiving higher education and other vocational courses. However, few flip side observed are, that there is some incidental indication that higher yields from Bt cotton do mean that children are kept out of school more often during July to September (the harvest period).

Further digging deep into the livelihood impact of Bt and the critical thesis and antithesis that captures the news pretty frequently is the cord that connects farmers suicide and technology adoption or use of Bt. In my earlier write up above I reflected that Bt is nowhere responsible or the soul trigger of farmer's suicide, there are multiple parameters that derive the farmers towards the brink of suicide.

NOTES

1. Genetically Modified (GM): (Life Sciences & Allied Applications / Botany) denoting or derived from an organism who's DNA has been altered for the purpose of improvement or correction of defects: *genetically modified food.*
2. This term describes an organism that has had genes from another organism put into its genome through recombinant DNA techniques.
3. James C (2011) Global Status of Commercialized Biotech/GM Crops: 2011.
4. Union of Concerned Scientists (2009): UCS Publications, Cambridge, MA.
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9. Stone GD (2011), Field versus farm in Warangal Field versus farm in Warangal 39:387–398.
10. Gruère G, Sengupta D (2011) Bt cotton and farmer suicides in India.

11. Qaim M, Zilberman D (2003) Yield effects of genetically modified crops in developing Countries. Science 299:900–902.

12. National Crime Record Bureau (NCRB) report on Vidharba, 2011.

13. Affected families implies the familes whose household head have committed suicide for one or the other reason.

14. The entire set of questionnaire has been attach in the end of the last chapter for reference.

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