

Perceptions of the Impacts of Genetically Modified Cotton Varieties: A Case Study of the Cotton Industry in Gujarat, India

Uma Kambhampati

Department of Economics, University of Reading, UK

Stephen Morse

Department of Geography, University of Reading, UK

Richard Bennett

Department of Agricultural and Food Economics, University of Reading, UK

Yousouf Ismael

Department of Agricultural and Food Economics, University of Reading, UK

The paper reports the findings of a study designed to consider the impact of the adoption of Bt cotton on markets, businesses, and institutional arrangements in India. Given that evidence to date suggests that widespread adoption of Bt cotton by farmers is likely to increase production, this study aims to assess possible implications for markets (access to inputs, prices of inputs and outputs, etc.) and local industries and to identify potential winners and losers. The results suggest that there are impacts on the cotton industry following from the release of Bt hybrids, and so far the impacts are most noticeable "upstream" (i.e., the input suppliers), where companies are rapidly moving away from the sale of bollworm insecticide and attempting to sell Bt seeds. Seed companies are looking for partnerships with Monsanto, the owner of the Bt gene. One reason that companies are keen to move away from insecticide is so they can avoid the need for credit supply to their customers. Seed purchase is not normally through credit, whereas insecticide purchase is. Issues for companies "downstream" (gins, textile manufacturers) relate more to the better quality of Bt cotton and the need for adequate segregation of Bt and non-Bt cotton.

Key words: Bt cotton, Gujarat, impact.

Introduction

India ranks third in global cotton production after the United States and China, and with 8–9 million hectares grown each year, India accounts for approximately 25% of the world's total cotton area and 16% of global cotton production. India produces almost three million tonnes of cotton per year; this includes cotton of all qualities and staple lengths. The cotton industry in India has 1,543 spinning units, more than 281 composite mills, 1.72 million registered looms, and an installed capacity of 36.37 million spindles. Since the New Textile Policy in 1985 (together with the liberalization of raw cotton imports), the industry has modernized itself significantly. Today, about 40% of India's spindleage is less than 10 years old, giving the industry an important edge over international rivals. The cotton industry contributes to industrial output, employment, and the balance of payments, making it one of the most important industries in the country. The textile industry, for instance, employs 30 million people directly and is the second largest employer after agriculture. It contributes 4% to GDP, 14% to industrial production and 27% to export earnings. Cotton provides a livelihood to more than 60 million people in India by way of support in agriculture, processing, and use of cotton in textiles, and also contributes 29.9% of the Indian agricultural gross domestic product (Barwale, Gadwal, Zehr, & Zehr, 2004).

However, a major limiting factor to both cotton production and quality in India is damage due to insect pests, especially bollworms (Lepidoptera; *Helicoverpa zea*, *H. armigera*, *Diparopsis castenea*, *Earias biplaga*, and *E. insulana*). These pests are usually controlled through multiple application of insecticides, which can be damaging to both the environment and human health. However, since March 2002 the government of India has allowed the commercial cultivation of a genetically modified form of cotton (Bt) which has resistance to bollworm. Bt cotton utilizes a gene from the bacterium *Bacillus thuringiensis* (Bt) that codes for proteins (endotoxins) toxic to bollworm. Following the release of Bt cotton in India, various studies have shown that it has a higher yield than non-Bt types and required less insecticide (which can be expensive) and labor for application (Barwale et al., 2004; Bennett, Ismael, Kambhampati, & Morse, 2004; Morse, Bennett, & Ismael, 2005b; Naik, 2001; Pemsil, Waibel, & Orphal, 2004; Qaim & Zilberman, 2003). Bt cotton also tends to have a better quality, in the sense that there is less damage and staining from bollworm attack, and hence is both cleaner and whiter. Higher yield, better quality, and less expenditure on insecticide and labor should result in better profits for the farmer, and one would expect that resource-poor farmers in the developing world will be eager to adopt the Bt varieties. Evidence to date suggests that this is the case in countries where the government has sanctioned

release of Bt cotton (James, 2002) including India (Bennett et al., 2004; Bennett, Ismael, & Morse, 2005; Morse et al., 2005a, 2005b; Qaim, 2003). Indeed, in India there has been a notable shift in discourse from government process related to decisions over the commercial release of Bt cotton towards economic impact and farmers (Yamaguchi & Harris, 2004).

However, the picture is a mixed one. Some reports suggest that Bt cotton does not have any significant advantage in terms of yield or gross margin over non-Bt types (Gala, 2005; Orton, 2003). Indeed, a reasonable criticism of many of the published studies which have looked at the economic impact of Bt cotton for resource-poor farmers is that they have focused at the farm level and only covered the years immediately following introduction of the new technology. Some of them are also based entirely on field trial data rather than “real” farm conditions (Gala, 2005). None of the studies address longer term impacts or indeed the sustainability of the technology in economic terms. For example, it could be argued that provided demand for cotton remains constant, an increase in production resulting from the introduction of Bt would inevitably reduce the price that farmers receive for their harvest but could boost exports. This has been noted for corn and soybean in the United States (Barkley, 2002). The impact this has on farmer’s income would, of course, depend upon the elasticity of supply of cotton to price.

Given the complexity of issues involved, it is perhaps no surprise that there have been relatively few studies of the impact which an agricultural technology can have “upstream” and “downstream” along the input supply-farmer-processing-retail chain in developing countries (Anania & McCalla, 1995; De Janvry & Sadoulet, 2002). Indeed, there have been few such studies for GM crops in the developed world.¹ It is this gap in knowledge that this research set out to fill, with reference to the growing of Bt cotton in India. Specifically, this study aims to assess possible implications for markets (access to inputs, prices of inputs and outputs, etc.) and local industries of the widespread adoption of Bt cotton and to identify the “redistribution of value” highlighted by Kalaitzandonakes (1998) that could result from restructuring.

1. Notable exceptions are Ebbertt (1998), Barkley (2002), and the report from Europa (n.d.).

Methodology

A survey of the impact of Bt cotton on the supply chain and its downstream effect was conducted in November 2004 in the Western Indian state of Gujarat (Figure 1). Although Gujarat’s major food crops are rice, wheat, maize, and groundnut, cotton and tobacco are the main nonfood crops. These cash crops dominate the state’s agriculture. In fact, cotton planted on the 1.75 million hectares in Gujarat contributes the largest single share (32%) of cotton output in the country (Singh, 2004). Gujarat is also home to one of the oldest cotton textile regions in the country, Ahmedabad, and as such provides a good region for studying the impact of Bt cotton both on the upstream sectors (seed suppliers, insecticide sales, etc.) and on the downstream sectors (gins, textiles mills, and garment manufacturers). An outline of the cotton industry in Gujarat is shown in Figure 2.

As set out here, the chain begins with the seed producers and distributors, in particular the companies responsible for producing the Bt hybrids. Monsanto is the owner of the Bt gene, but it works in partnership (50/50 venture) with another company as Mahyco-Monsanto Biotech Ltd. (MMB). Monsanto’s Bt gene was introduced in three of Mahyco’s Mech Hybrids, creating Mech 12, Mech 162, and Mech 184. The profit derived from the seed sales and technology fees are then shared between the two companies. Its Bt cotton hybrids have been very successful with exponential sales since its introduction in 2002. In 2004 there were some 500,000 hectares (11% of all hybrid cotton planted), representing an increase of 400% over 2003. Monsanto has also teamed up with other seed producers—Rasi, Ankur, and Nuzividu—and plans to release commercially the Bt hybrids Rasi 138Bt, 134 Bt, 144Bt, and 317Bt. There are some 19 other Bt cotton hybrids in field trial.

The Bt Mech hybrids are currently sold through a network of dealers at the national (e.g., Rasi seeds), regional/state (e.g., Gujarat State cooperative), district (e.g., Royal seeds), and even taluka/village² (e.g., Namada Seed Agency) spatial scales. Some of these dealers will also sell other inputs such as pesticides, fertilizers, and machinery. None of the dealers included in the study claimed to be selling “unofficial” Bt cotton.

The seed and input suppliers are upstream from the producers. Downstream from the producers there are gins and spinners at village, state, and national levels; particularly at the national level, gins and spinners will

2. A taluka is an administrative division in India below a district.

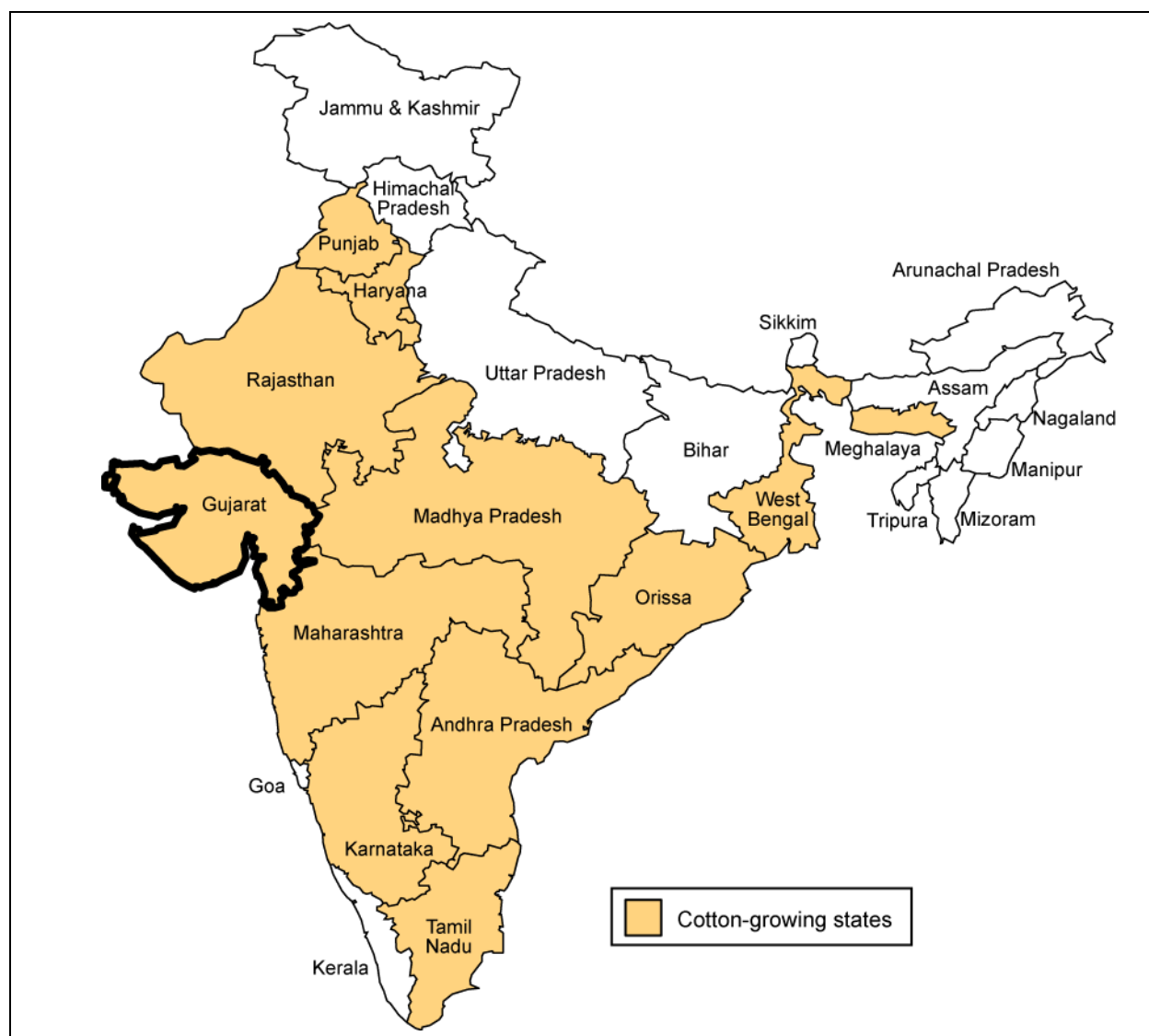


Figure 1. The cotton-growing areas of India.

also be involved in the production of garments for the home market and for export.

In 2004 a total of 22 companies in the chain from three districts in Gujarat were interviewed using a semi-structured questionnaire, 17 upstream (five seed producing and distributing companies and 12 input suppliers) and five downstream (Table 1). The companies were stratified in terms of their spatial scale of operation, although the division is simplistic. In addition to the companies, three other institutions were also included in the sample: Gujarat Cotton Research Institute, Ahmedabad Textile Industries Research Association (ATIRA), and Ahmedabad Textile Mills Association (ATMA).

The first of these is a state-funded research institute in cotton, and the others are trade associations.

The majority of the companies were clustered in the northern part of Gujarat in the Sabarkantha, Ahmedabad, Gandhinagar, and Mahesana districts (Figure 3). The cotton industry is located across a number of other districts in the state (notably the more southern districts of Jamnagar, Junagadh, Bharuch, and Surat; Figure 3), but due to logistical constraints these were not included in the study.

The semi-structured questionnaire was designed to capture background information about companies, their perception of changes prior to and after the introduction of Bt cotton, and how Bt cotton has affected them. (A

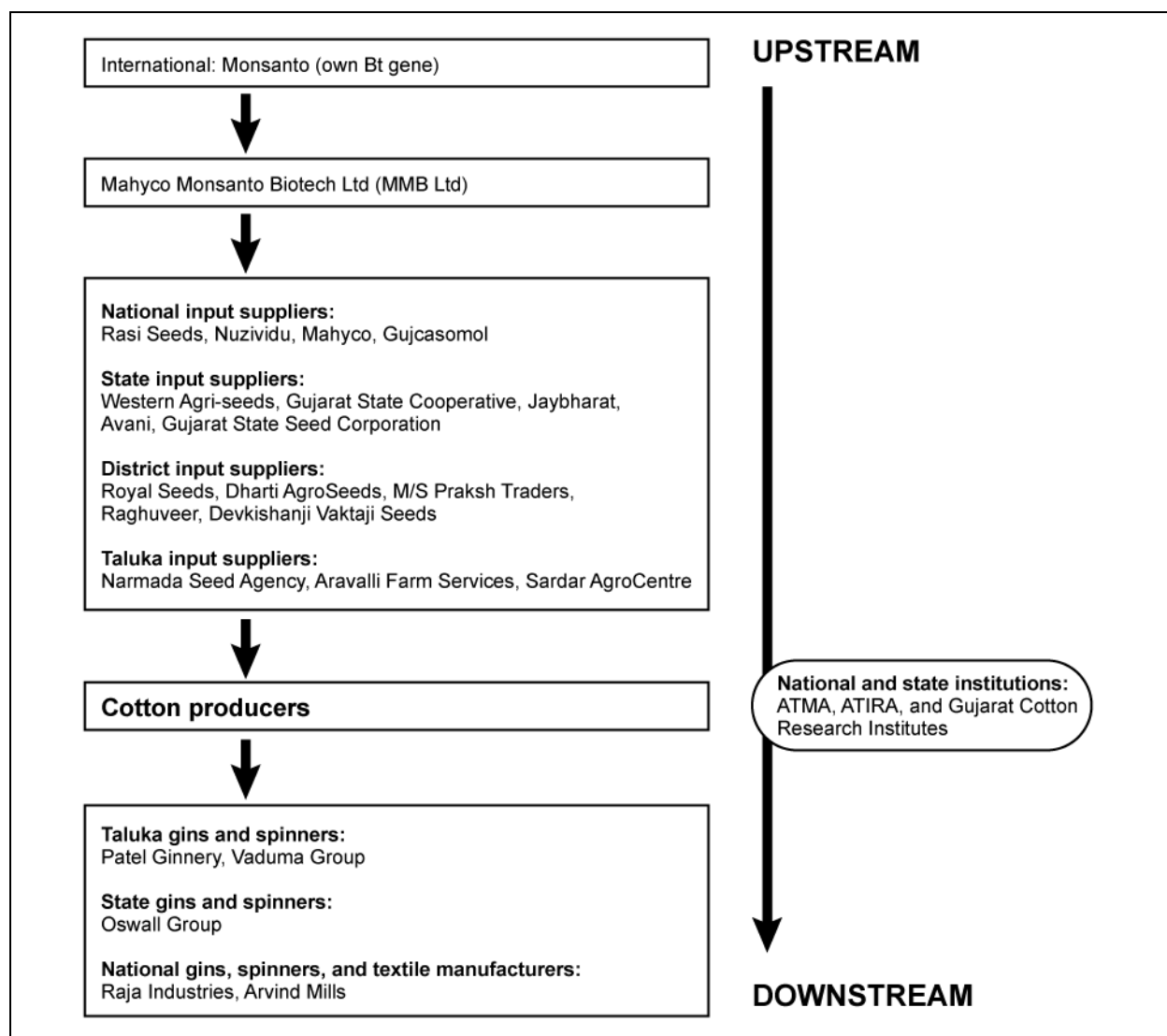


Figure 2. The cotton supply-producer-market chain with example companies at each level of the chain.

listing of the questions asked is provided in the Appendix). Before we analyze the results of the interviews in any detail, it is worth stressing that the interviews represent a very limited sample and should therefore be considered in this light.

Results

The perceived advantages of Bt cotton from the perspective of the respondents are presented in Table 2, and a summary of the main findings of the study in terms of impact and response is presented in Table 3. In Table 3 the respondents have been divided into two categories: upstream (the input suppliers) and downstream (the ginneries, spinners, and garment manufacturers).

Upstream Impacts

Table 2 identifies the main impacts that firms (upstream and downstream) perceived as resulting from the production of Bt cotton. When asked what the main benefits of Bt cotton were, 11 of the seed and input supplier companies mentioned a reduction in insecticide use, while nine reported a higher production, and three (two of which were Mahyco-Monsanto and Monsanto) mentioned a reduction in losses due to pests. Asked whether Bt cotton improves quality, 13 of these companies said “yes” and only one (Gujarat State Seed Corporation) said “no.” It is interesting to note that of the 17 seed/input companies, two (Mahyco-Monsanto and Monsanto) claim that Bt cotton provides less risk for farm-

Table 1. The 22 companies selected for the semistructured interviews categorized by main business and spatial level of operation.

Level	Upstream companies		Downstream companies	
	Seed producers	Seed suppliers	Input suppliers	Gins, spinners, garments
Taluka/village		Narmada Seeds Agency	Aravalli Farm Services; Sardar Agro Centre	Vaduma Group; Patel Ginnery
District			Raghuveer; Devkishanji Vaktaji Seeds; Royal Seeds; Dharti Agro Seed; M/S Prakash Traders	
State	Avani Seeds	Gujarat State Seed Corporation	Western Agri-seed Private Ltd.; Gujarat State Cooperative Marketing Federation Ltd.; JayBarat Agro Seed	Oswal Group
National	Mahyco-Monsanto Biotech; Rasi Seeds Ltd.; Nuzividu Seed Ltd.			Raja Industries
International	Monsanto			Arvind Mills Ltd
Number of companies	5	2	10	5

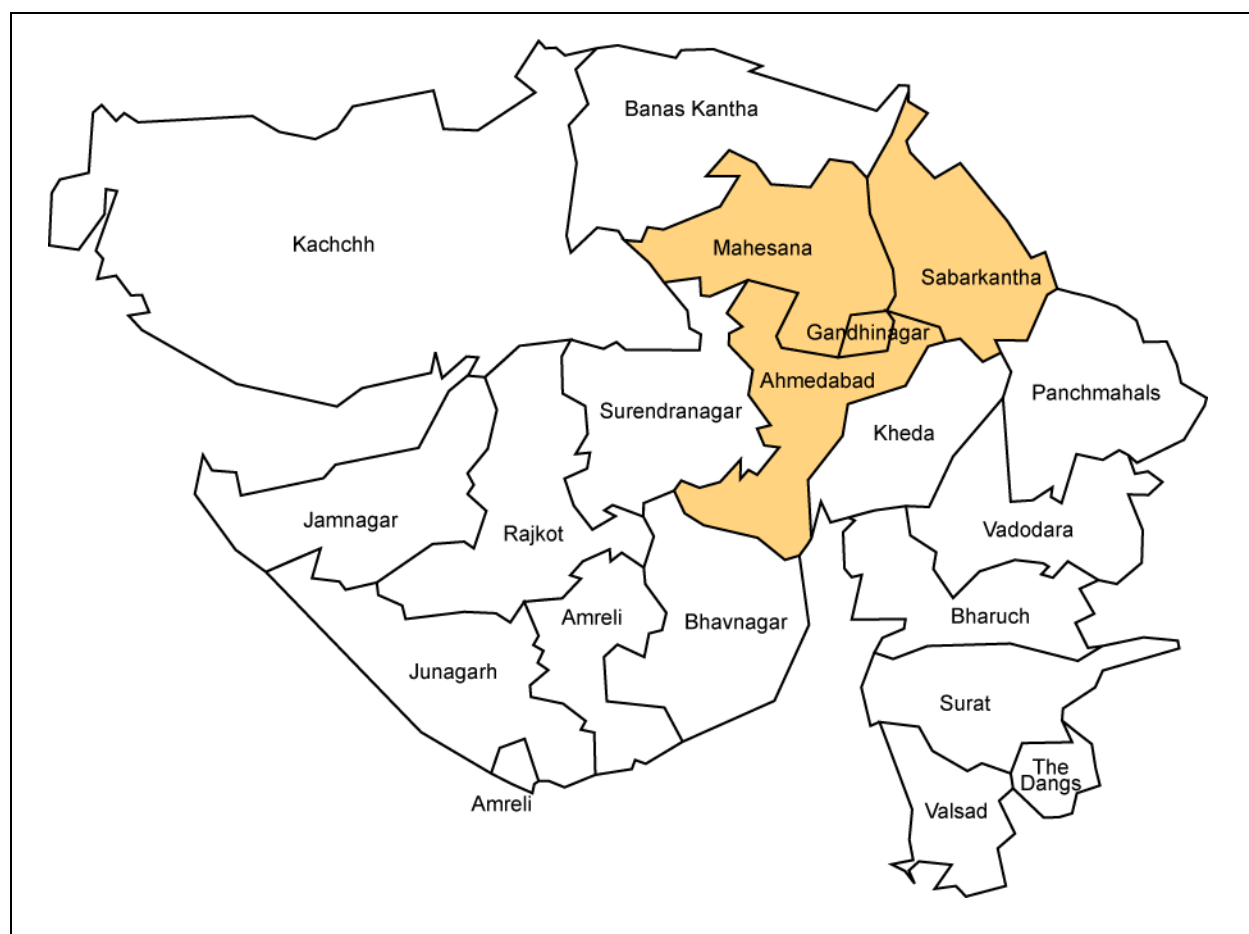


Figure 3. Districts of Gujarat State. Respondents in the study were clustered in the Sabarkantha, Ahmedabad, Gandhinagar, and Mahesana districts.

Table 2. Perceived advantages of Bt cotton.

	Level	Producer/supplier	Insecticide savings	Reduction in losses due to pests	Better quality	Less risk for farmers	Higher production	
Seed distributors	Village	Narmada Seeds Agency	Y		Y		Y	
	State	Gujarat State Seed Corporation			N		Y	
		Avani Seeds	Y				Y	
Seed producers	National	Rasi Seeds Ltd.			Y		Y	
		Nuzividu Seed Ltd.			Y		Y	
	National	Mahyco-Monsanto Biotech	Y	Y	Y	Y		
	International	Monsanto	Y	Y	Y	Y		
Input suppliers	Village	Aravalli Farm Services	Y		Y		Y	
		Sardar Agro Centre	Y		Y		Y	
	District	Raghuveer				Y		Y
		Devkishanji Vaktaji Seeds	Y			Y		
		Royal Seeds			Y	Y		Y
		Dharti Agro Seed	Y			Y		
		M/S Prakash Traders	Y			Y		
	State	Western Agri-seed Private Ltd.						
Gujarat State Cooperative Marketing Federation Ltd.		Y			Y			
JayBarat Agro Seed		Y						
Gins, spinners, garments	Village	Vaduma Group			Y			
		Patel Ginnery			Y			
	State	Oswal Group			Y		Y	
	National	Raja Industries			Y		Y	
International	Arvind Mills Ltd.			Y				
Institutions	State	Gujarat Cotton Research Institute	Y				Y	
		Ahmedabad Textile Industries Research Association	Y				Y	
		Ahmedabad Textile Mills Association				Y		

ers. However, none of the other companies picked up on this. Clearly the most apparent advantages to the respondents were savings in insecticide, better quality, and higher production (see Table 2); these results are unsurprising and mirror the results from the farm-level studies referred to earlier.

Perhaps more surprising was the response to a question asking whether respondents felt that the Bt technology would last. Only seven of the 17 companies (i.e., 41%, including Mahyco-Monsanto and Monsanto) gave an unambiguous “yes” answer, while four said that they “didn’t know” and one other respondent provided an unambiguous “no.” New ideas come and go in the cot-

ton business, and some respondents clearly had doubts as to whether Bt cotton would last.

The views of Monsanto regarding the future of Bt cotton in India are understandably positive:

The commercialization of Bt cotton is benefiting cotton producers in India. They use less insecticide, have lower cost and have peace of mind. The mills have better quality and cleaner cotton.... At present we saw an increase of 30% in yield, which is equivalent to £1 billion for India.... Our aim is to work with all the cotton seed companies in India and to introduce Bt gene

Table 3. Summary of main findings.

	Level	Impacts	Response
Upstream	Seed suppliers	Demand for Bt varieties increasing	Increasing collaboration with Monsanto
	Input suppliers	Demand for insecticides decreasing	Turning to sales of Bt seed varieties
Downstream	Gins, mills	Very little so far, though quality of Bt cotton is good	Calling for more segregation of Bt and non-Bt cotton

in most of the important cotton hybrid in India. We are currently working with Mahyco, Rasi, Ankur, and Nuzividu and aim to release some 20 Bt hybrids. (Marketing Manager and Scientific affairs, Monsanto India, 10/26/04)

Alongside this optimism, Monsanto did voice concerns regarding resistance management, the introduction of the illegal Bt varieties, and public relations. Thus, there has been considerable resistance to Bt cotton in Andhra Pradesh, for instance, where the failure of the seed to raise yields in the 2002/3 Kharif³ season led the government to promise compensation to farmers.

It might be expected that the main upstream impacts of the adoption of Bt varieties would be on insecticide firms and seed producers and suppliers. The responses differed at least partly based on what part of the supply chain the firms occupied. Thus, seed producers had a different response from seed distributors, as we will see below. Thus, GM varieties would imply lower insecticide costs but higher seed costs for cotton farmers. In this context, it is not surprising that seed producers and distributors are prospering, and companies like Jay Bharat, Dharti Agro, and Sardar Agro Centre, which primarily sell insecticides, are losing out. In fact, these companies are trying to diversify into the production of GM seeds:

Bollgard cotton is affecting my business a lot. We deal mainly with cotton insecticides, and our insecticides sales are down by 40%....We are learning quickly and are now selling Bt cotton, which is good for us in terms of cash flow, because farmers like to pay for seeds in cash.... We don't think we will sell cotton insecticides in

the next five years, especially bollworm insecticides. (Owner, Jay Bharat Agro Seed, 10/22/04)

Declines in insecticide sales reported from these companies of 20–75% are substantial, but it would appear this is being more than compensated for by increased sales of Bt cotton. What choice do the companies have? It does imply, of course, that these companies will carry lower stocks of insecticide, so if there is an upsurge in bollworm damage as a result of a collapse in Bt resistance, the farmers could be vulnerable.

Many seed producers are linking up with biotechnology research companies like Monsanto to survive. There is evidence of increased mergers or other alliances in this industry. Thus, Rasi Seeds, which has faced a 3–4% decline in annual sales, has teamed up with Monsanto to release a Bt hybrid in 2004–5:

Bt cotton is seriously affecting our seed sales, and in some regions our sales have been 20% less than last year. We are now working with Monsanto and MMB Ltd. and are planning to release our own Bt cotton, that is, 138 Bt, 134 Bt, 144 Bt, 317 Bt, and others. We had to have our own Bt cotton; otherwise, we would not be able to compete in the cotton seed market.... I think that Bt cotton has a good future in India provided farmers manage it well. (Regional Director, Rasi Seeds, 10/24/04)

Similarly, Nuzividu Seeds, a large seed breeder and distributor in India, has also teamed up with Monsanto to release their own hybrid in 2004–5:

We have suffered in terms of lower seed sale in India because of Bt cotton. In Gujarat our sales have dropped by 10% in the last two years.... Monsanto will introduce their Bt gene in our cotton line in 2005 and thus we can then compete in the cotton seed market. (Regional Manager, Nuzividu Seeds, 10/20/04)

Thus, there are signs of increasing technological collaboration within the seed production sector with companies responding to the success of Bt cotton by attempting to “buy into” the same product rather than differentiate. This has also increased the monopoly power of the main Bt gene provider—Monsanto—within the sector. This experience reflects that of the United States and Europe with GM corn and soya, where the new technology caused increasing concentra-

3. *Kharif* refers to a crop that is harvested at the beginning of winter.

tion upstream both through mergers and through technological collaborations (Demont & Tollens, 2001).

Amongst the companies which concentrate on seed distribution rather than production there is also considerable change, but the impacts are more variable. Companies which specialize mostly in noncotton seed are noticing little change in their core business but have noted the success of others. The following quotation is an example:

My company deals mostly with vegetable seeds and we can say that we do not sell many cotton seeds, and Bt cotton had little effect on my business with the exception that our insecticide sales are low this year.... My other friends in the cotton seed business tell me that Bt cotton is good and has increased their profit and have more cash business. I am planning to sell more Bt cotton next year. (Owner, Devkishanji Vaktaji Seeds, 10/22/04)

Many seed producers and distributors within the cotton sector are prospering from these changes, but they are also finding it hard to survive without GM inputs. As Avani Seeds has found, their sales of conventional cotton seeds has dropped by 50% in two years. They are a state-wide company but have not been given permission to sell the Bt variety; as a result, they are facing hard times. They are not the only ones. Even at taluka/village level, companies not yet selling Bt cotton are having to make decisions:

I know that Bt cotton is a good cotton, but we are not selling it yet, and our old hybrids sale is down by 15% from last year. Many farmers are asking for it, and we must decide soon if we will sell it. Our maize business is strong, but selling Bt seeds could boost our business further, because farmers like to pay cash for seeds. (Owner, Narmada Seeds Agency, 10/21/04)

Many seed companies (such as Western Agri-Seeds and Royal Seeds) are also finding that the reduced insecticide inputs have meant that they no longer need to provide credits to the farmers for buying insecticides. This has meant that they can avoid the costly process of ensuring repayment of that credit.

We have been lucky to start selling Bt cotton once it was commercialized in India. We are more prosperous and our Bt seed sales is expand-

ing, which meant that we have more cash business and we do not have to knock on farmers' doors to collect debt (those farmers who take insecticide on credit).... Personally, I would like to see the gene being put in more local Indian hybrids. (Manager, Western Agri-Seeds, 10/20/04)

Clearly, the signs are that these companies are looking to move away from cotton insecticide and embrace the Bt technology. Such a shift is feasible for distributing firms but is likely to be harder for firms that actually produce the insecticides. The benefits of reducing their involvement in credit for insecticide is attractive, especially as farmers pay for seeds with cash. There are obvious benefits for the cash flow of these companies.

Downstream Impacts

None of the downstream companies (gins, spinners, and garment manufacturers) mentioned insecticide savings, reduction in losses due to pests, or less risk for farmers as advantages of growing Bt cotton. However, all of them mentioned an increase in quality, and two of the five stated that production of Bt cotton is higher. This is not surprising, given that the upstream companies would be concerned with quality and production issues rather than pest control. At the moment the gins are happy to pay a higher price for Bt cotton given the improvement in quality:

We give Bt cotton a premium price of up to 20% because it is cleaner and has less trash and the lint is easily extracted from the seed and Bt cotton is boosting our profit margin.... Bt cotton seed were sold at Rs1100 per 20kg instead of the usual Rs180/kg and were sold to farmers, and this caused a boom in the illegal Bt cotton seeds trade. (Owner, Vaduma Group, 10/24/04)

From our experience, we know that Bt cotton is cleaner and whiter, and we pay farmers a higher price for it, and also it has a higher extraction rate of 3–4%.... Cotton merchants like Bt cotton, and they are prepared to pay up to 20% higher price for Bt cotton, and just like us they would like to see farmers segregating cotton. (Owner, Oswal Group, 10/25/04)

A 20% premium is a significant enticement for farmers beyond the gains in yield and reduced insecti-

cide costs. However, note the last point about segregation in the quotation from the owner of Oswal Group. All the interviewees in the survey claimed that farmers are not segregating Bt and non-Bt cotton. This has meant that there is little distinction between the two by the time the cotton arrives at the mills. They argued that the next step in maximizing the benefits from Bt cotton is to increase the segregation of such cotton.

However, although the quality of the Bt cotton is good (as a result of less staining of the bolls from bollworm), there are criticisms of the genetic background within which the Bt gene is located:

I think that Bt gene will be better off in another hybrid such as Shankar. At the moment, the old Mech hybrids already have a high micronair of about 4.2, and the insertion of the Bt gene in the Mech hybrid has increased the micronair to 4.6. The reason is that the reduction in pest damage, especially in the first bolls, meant that these first bolls have a longer time to mature.... We at Arvind reap the benefit of cleaner and whiter cotton, but the cotton is rougher, and that is not good for fine garments, but is suitable for coarse garments. (Chief Manager, Arvind Mills Limited, 10/25/04)

As a result, there were calls amongst respondents for the Bt gene to be inserted into better (from their point of view) genetic backgrounds. Indeed, one respondent from the Ahmedabad Textile Mills Association (ATMA) suggested that the government should purchase the Bt gene and insert it into a finer cotton hybrid.

Segregation of Bt and non-Bt was also an issue. One respondent from ATMA said that

...we would like to see farmers, merchant, ginners segregate their cotton, but the source of the problem is the farmers and merchants who mix their cotton. Having said that, I think that given the premium that Bt cotton receives, this could encourage farmers to segregate their cotton.

Thus, the impetus for segregation of Bt and non-Bt varieties in the cotton sector arises from the possibility of improved quality in the downstream sectors. This is of course quite different from the calls for segregation and identity preservation in GM food crops where this has arisen from the need for consumer protection rather than producer profits.

Generally, the ginners, spinners, and garment manufacturers were supportive of the Bt cotton and felt that it has helped their business. Thus, the Chief Manager of Arvind Mills, which supplies the international market with cotton cloth (denim jeans) and garments, has said that Bt cotton has helped to increase the supply of cotton, and this in turn has enabled Arvind Mills to increase its output. A similar point is made by Raja Industries, which claims that the higher extraction rate (of 35% for Bt cotton as opposed to 32% for non-Bt cotton) has meant higher income for their gins. The owners of the Oswal Group, Vaduma Group, and the Patel Gineries all make a similar point. Four of the five companies (80%) felt that the Bt technology would last—a much higher proportion than seen with the downstream companies.

The impact of using Bt varieties at the farm level is an increase in supply and therefore possibly lower prices, provided demand remains the same. This would be expected to translate into lower cloth prices. Given India's exports of cotton cloth, this might be expected to help improve export figures if India manages a first-mover advantage. This would also require that the current mistrust of GM varieties in the food sector in the West is not translated to cotton products as well.

Discussion

It should first be stressed that the survey conducted was a limited one, including only 17 upstream (including Mahyco-Monsanto and Monsanto), five downstream and three institutions in a single (albeit important) state in the cotton industry in India. This is therefore a small sample of all the companies that form the cotton industry in Gujarat and India, and the views summarized in the paper need to be considered in this context. Even so, the results do provide much food for thought.

The trends reported here in terms of a lessening of pesticide sales as a result of the introduction of Bt cotton mirror those reported by others in the developed world (Hayenga, 1998). There is also an increased readiness for input suppliers to reduce insecticide sales given its linkage with credit and the problems of recovery. This is an important concern and one that is often overlooked when credit is discussed. The emphasis is typically upon the impact that Bt cotton has upon those receiving credit—the producers—but the other side to this is that credit can be expensive to provide. A combination of less market demand and the attraction of marketing seeds that do not have the problems of credit are under-

standable pressures which act to reduce insecticide sales.

An improvement in quality with Bt was reported by most of those involved in the survey, and was especially emphasised by the downstream companies. It is understandable that ginneries, spinners, and garment manufacturers would be more likely to highlight the quality of the cotton, but the point was also made by many of the seed and input suppliers. Although the downstream companies have concerns over the genetic background into which the Bt gene has been inserted and segregation, overall their responses are positive. Maximization of the benefits of Bt cotton in the downstream sector, however, will require segregation of Bt and non-Bt cotton along the supply chain. This could become both expensive and inconvenient, and it remains to be seen whether this will be done.

Allied to the above is the often-claimed benefits to farmers, at least in the studies conducted so far (Barwale et al., 2004; Bennett et al., 2004; Morse et al., 2005b). Less insecticide purchase, less reliance on credit, more yield, better quality, and higher prices associated with Bt cotton all combine to suggest that producers will earn more and have less risk. Indeed, some of the respondents in the survey argued that of all those in the chain, it is the farmers who have benefited most!

So far it would seem like a “winners all around” story of success, but is this too good to be true? One obvious note of concern is the increasing concentration within the input supply sector and even the risk of bankruptcies if some companies cannot adapt. Seed companies were almost rushing to form a partnership with Monsanto so they could incorporate the Bt gene in their backgrounds, and insecticide suppliers were clearly trying to get into the Bt business. However, should this be a concern? At one level it can be argued that the agricultural sector has passed through such a process many times before as popular technologies have entered the market. Even so, the dominance of one company supplying a single gene for incorporation into so many backgrounds is unique.

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Appendix: Questions Asked in the Semistructured Interview

Note that the questions listed here for sections 2, 3, and 4 were intended as points for discussion rather than as inviting closed answers.

Section 1. Background Information

Company/institution name:
Location of company/institution:
Name of respondent and position:
Type of company ownership:
Date company/institution began operation:
Type(s) of business:

Area of operation:
Annual sales (million Rs):
Number of workers employed by company/institution:
Number of managers working in company/institution:

Section 2. The Business

Main commodity(ies) traded in by company:
Main strength(s) of company:
Where are the products sold?
Main competitors:
Main changes observed in the last five years:

Section 3. Impact of Bt Cotton

When did you first hear about Bt cotton?
In your opinion what are the main benefits of Bt cotton?
Do you think that Bt cotton improves quality?
What are the main problems associated with Bt cotton?
Will Bt cotton last?
What are the main impacts of Bt cotton on your business?
How would you improve your company?

Section 4. Additional Comments and Further Findings

Acknowledgements

Data analysis was funded by the United Kingdom's Department for International Development (DFID; project MC/GEA/004, "Monitoring the impact of GM cotton in India"). The views expressed are not necessarily those of DFID.