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Local and Global Elites Join Hands

Development and Diffusion of Bt Cotton Technology in Gujarat

While experts and activists question genetically engineered seed technology in the name of farmers' interests and a greater democratic future, farmers themselves are voting with their feet in its favour. The development and diffusion of Bt seed technology by farmers in Gujarat implies that it finds a smooth insertion in the social and agrarian space shaped by the technological culture of the green revolution. In fact, GM technology as a solution to the problems generated by the green revolution technological paradigm sustains and reinforces the hegemony of global and local elites. Though multiple global and local actors have joined hands in developing and diffusing the knowledge on Bt cotton seeds, this multipolarity neither ensures automatic democratisation nor the multiculturalism of technology.

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The debate on the social and environmental appropriateness of genetically engineered organisms has entered a crucial phase in the context of the events around the introduction, diffusion and performance of Bt (bacillus thuringiensis)[1] cotton seeds in India. Thousands of farmers from Gujarat, Andhra Pradesh and Karnataka cultivated so-called "pirated" or "illegal" seeds supplied originally by the Navbharat seed company under the name of Navbharat-151 (hereafter N-151) at least three years before the Bt seeds of Mahyco-Monsanto Biotech (patent protected by Monsanto) were approved by the Genetic Engineering Approval Committee (GEAC). Even after the seeds supplied by the Mahyco-Monsanto Biotech (hereafter MMB) have been commercially released in India, farmers continue to cultivate "illegal" seeds, which are multiplied locally. Furthermore, according to a survey conducted by some independent researchers [Sahai and Rahman 2003; Sahai and Rehman 2004; David and Sai 2002] also widely acknowledged in the media ('A Can of Bollworms', D Bunsha, Frontline, 18(24), 2001) and confirmed by the farmers from Gujarat during my interviews (in January 2005), the locally multiplied seeds seem to be performing better than the patented seeds of Mahyco-Monsanto in terms of both pest control and yield.[2]

The sheer existence and popularity of "illegal" Bt cotton seeds posits a paradoxical problem. As some scholars argue, biotechnology and genetic engineering has become a site for democratic imagination in India [Vishvanathan and Parmar 2002]. The proponents and opponents are fiercely debating a variety of potential situations that genetically modified organisms may entail, for instance, social and environmental risk, impact on human health, eradication of

hunger and poverty and monopolisation of scientific and technological knowledge. While this dialectical moment of a battle between the thesis and anti-thesis is maturing [Glover 2002], farmers have quietly appropriated and adopted the genetically engineered knowledge on cotton seeds. This paper is an effort to explain this paradox: while experts and activists question the technology in the name of farmers' interests and a greater democratic future, the farmers on the contrary are voting with their feet in favour of the technology.

This paper is an attempt to explain why cotton-growing farmers have popularly adopted Bt seeds produced originally from Navbharat seeds. Put in different words, the paper explains the cultural, productive and environmental context within which users – cotton growing farmers in this case – make their choice (from among contending options), develop and diffuse the genetically modified seeds. I intend to make two arguments: firstly, Bt seeds technology represents a technological culture with a specific value framework, which is endorsed commonly by both the multinational company and cotton growing farmers of Gujarat. And secondly, the Bt seed technology has been popularly adopted by the farmers because it fits very well in the currently dominant the local and global agrarian context.

I would ultimately like to propose that the framework of back-end risk assessment or the potential threat of monopolisation of knowledge or dynamics of the regulatory framework may not be sufficient to evaluate the appropriateness or social desirability of genetically engineered crop technology, as they do not address front-end issues such as the social context of technological choice [Scoones 2003, Wynne 2002, Maat 2000]. I ultimately hope to raise the point that the appropriateness or social desirability of genetic engineering of crop technology should be understood with respect to wider issues concerning democratisation of technological culture (which would also entail democratisation of social and agrarian relations) and not in the narrow frame of risk or knowledge control.

The story that the Indian government did not accept Monsanto's offer to discuss technology transfer is well known now. So are the controversies around field trials and lacunae in the regulatory framework. They have been recounted elsewhere [Gupta and Chandak 2004] and I do not repeat them here. What is important to narrate here is the story that is more specific to Gujarat.

At the time when the application of MMB for the commercial release of Bt cotton seeds was pending in front of the Indian government and when the field trials were going on in 2001, it was discovered that Bt cotton seeds were being commercially cultivated in at least 10,000 acres

in Gujarat. The seeds were traced back to Navbharat Seeds. It was also discovered that Navbharat was in the business of selling seeds for at least three years before 2001. On testing the seeds, which were being sold in the market as a hybrid variety and not as genetically modified, the Bt Cry 1 AC gene patented by Monsanto was found. Given that Navbharat sold genetically engineered seeds without taking prior permission from the Indian government, Genetic Engineering Advisory Committee (GEAC) declared them illegal and ordered the Gujarat government to burn the standing crops in the fields, although by that time much of the cotton produce was already in the market. Based on the complaint by MMB a case was registered in the Gujarat High Court against Navbharat. It would be important to note here that in 2001, in addition to MMB, the Gujarat Seeds Producers Association (of which Navbharat seeds private limited was also a member) filed a petition (with the signature of all other members except Navbharat) with the secretary of the department of biotechnology taking objection to the cultivation of Navbharat 151 seeds and expressing concern that the cross-pollination of Navbharat transgenic seeds may result in the widespread contamination of genetic biodiversity and the environment and could even be detrimental to human and animal health. The Gujarat Seeds Producers Association requested the department of biotechnology to intervene and uproot the existing Bt cotton crop in the fields and also to stop the crossing of seeds for widespread multiplication by farmers.[3]

In March 2002 three varieties (Mech 12, Mech 162 and Mech 184) of MMB were given permission for commercial release in the six states of Maharashtra, Gujarat, Madhya Pradesh, Karnataka, Tamil Nadu and Andhra Pradesh. These approved varieties seem to have been developed to suit agro-climatic conditions of the south and central India (including western India). Mech 915 was not given approval, which is supposed to have suited the agro-climatic conditions of the north India. On the release of commercial varieties of Bt cotton the green political groups became red, showing their disapproval of the approval by GEAC. On the contrary, farmers' leaders such as Sharad Joshi welcomed the move and accused pesticide makers and pseudo-scientists of depriving Indian farmers of access to genetically modified technology for seven long years ('Mahyco Monsanto Marketing JV to Educate Farmers on Bt Cotton', S Nagaraj, *The Economic Times, A*pril 6, 2002). Nagaraj further reports, in the same issue of *The Economic Times,* Ahmedabad, quoting a member of GEAC, that MMB seeds cannot be compared with N-151 in terms of yield.

The events of the next three years resonated with Sharad Joshi's view about how farmers preferred genetically engineered cotton seeds and an unknown GEAC member's view that Navbharat seeds were superior than MMB seeds. Gujarat farmers massively adopted Bt seeds, allegedly not

those marketed by the MMB but N-151, which were locally multiplied and sold by several seed companies and farmers themselves. As shown in **Table 1**, although the area under cotton in Gujarat marginally grew from 16.15 lakh hectares in 2000-01 to 16.28 lakh hectares in 2003-04, both total production and yield were more than tripled in 2003-04. Almost 19 lakh hectares are expected to be under cotton cultivation in the last season (2004-05) when total production seems to have touched 54 lakh bags and average yield 483 kg per hectare. The increase in total production and yield are often attributed to the cultivation of Bt cotton seeds, though some scholars have argued that the increase in yield could also be due to good rainfall in the past three years [Sahai and Rehman 2004]. What is being claimed widely is that locally multiplied seeds of generic N-151 (more on the multiplication of N-151 follows) were cultivated in a minimum of 60 per cent to a maximum of 80 per cent of the total area under cotton in Gujarat in the last two years.[4] Not only that but the "illegal" N-151 seeds were widely believed to have performed better than officially released varieties of MMB.

Table 1: Area, Production and yield of Cotton in Gujarat

	2000-01	2001-02	2002-03	2003-04	2004-05 (estimated)
Area (hectares)	16,15,400	17,49,800	16,34,800	16,28,000	19,00,000
Production (bags)	11,61,400	17,02,700	16,84,500	45,00,000	54,00,000
Yield (kg per hectare)	122	165	175	469	483

Note: One bag of cotton is approxmiately 170 kgs.
Source: Information provied by Gujarat Agricultural Development as published in Metha and Patel (2004).

In response to a petition filed by the Gujarat Seed Association (the turn taken by Gujarat Seeds Association is discussed later in the paper) this time complaining about the disappointing performance of the Bt varieties marketed by the MMB, the Gujarat government constituted a committee to look into the matter. Based on the visit to eight districts, the committee acknowledged that roughly 35 to 100 per cent of the Mech 184 variety of MMB, 5 to 15 per cent of Mech 162 and Mech 12 dried up in an untimely way. All the three varieties were also reportedly inflicted by sucking pests and by the most devastating pest of American bollworm – locally known as green worm (scientific name "heliothis armigera") – against whose attack the Bt seeds have been genetically engineered to

protect. The committee gave a clean chit to the seeds developed from N-151 both in terms of performance against pest attack, yield and also response to other environmental conditions [Mehta and Patel 2004].

The cultivation of Bt cotton is one story; the multiplication of Bt seeds is another. Even after N-151 seeds were declared illegal, according to one estimation, during the year 2004 -05, N-151 seeds were multiplied in 20,000 acres in Gujarat, from which 60 lakh packets of seeds were prepared (one packet contains 450 gm of seeds which is roughly enough for one acre). Gujarat alone has a demand of roughly 24 to 25 lakh packets, of which only 2 to 3 lakh packets were supplied by the MMB, the rest were N-151. That also means that roughly half of the seed packets produced in Gujarat are sent to other states.[5] The multiplication of generic N-151 seeds has happened in two ways: (i) seed companies give contracts to farmers to multiply seeds, which are bought back at Rs 300 to 400 per kg, packed and sold at Rs 700 or 800 or even Rs 1,200 to 1,500 per packet during the peak season. (ii) Farmers themselves multiply seeds which are sold to the "known" farmers from the same social and kinship background.

The most crucial issue that is pending in front of the Gujarat government is the request from Gujarat Seeds Producers Association. In its request the Association seems to have been voicing a widespread feeling, especially among cotton growing farmers and seems to have taken a complete turn on the issue of the legitimacy of N-151. The Seeds Association, in contrast with its earlier complaint against Navbharat is now requesting the Gujarat government to regularise and legalise the multiplication and sale of N-151 seeds. The Association has made two proposals in the petition submitted to the chief minister of Gujarat: (i) Navbharat gives away its technology of the seeds production to the Gujarat government. The government then distributes foundation seeds to seed companies for multiplication and sells the ready seeds at a price substantially less than the market price offered by the MMB. This arrangement would be somewhat similar to what happens in case of hybrid cotton seeds. Or, (ii) the Gujarat government legalises the sale of N-151 seeds under the clause provided in the Environment Protection Act and Rules 1986 (EPA) for the deliberate and unintentional release of micro-organisms and genetically engineered organisms according to which seed companies would be allowed to multiply and sell seeds in the regular market. Given that the permission given to MMB for the commercial release of Bt seeds has come in for revision in April 2005 and given also that the patent bill was recently passed in the Lok Sabha – ratifying the international patent regime according to which cultivating Bt seeds, other than those marketed by the MMB, would entail violation of patent held by Monsanto and be punishable – the issues related to

Navbharat seeds stand at a crossroad.[6]

The above narration clearly suggests that the risk related to the cultivation of Bt seeds is hardly an issue for cotton-growing farmers in Gujarat. Farmers' demands are not even about seed control as activists like Vandana Shiva would like them to be. In fact, the cultivation of Navbharat seeds on a massive scale endorses the Bt seed technology originally developed and marketed by the multinational company. The bone of contention however is about finding legitimacy for a technology that is modified/redesigned and massively supported by the users/cotton-growing farmers. The following is an attempt to understand the context of farmers' participation in the modification and multiplication of a technology originally developed by a multinational company.

Technological Paradigm

Bt Cotton Technology and Global Context

The international players – Monsanto (and many other agro-chemical companies) – started to transform their enterprises into life science industries in the late 1980s and the early 1990s. In the leadership of Robert Shapiro, in the decade of 1990s, Monsanto shifted its market and research priorities from chemicals (produced originally for warfare and industrial use) to life sciences. For his attempts to harness the potential of biotechnology to revolutionise agriculture as information technology did to communication, Shapiro is nicknamed the "Bill Gates" of biotechnology [Vellema 2004]. However, the shift in Monsanto to the development of biotechnology has as much to do with market conditions as with the changing thinking pattern of the leadership.[7]

Here, I would like to highlight two points about the configuration of Monsanto's biotechnology that are relevant for the present paper. Firstly, at its inception Monsanto's biotechnology programme was meant to support and increase its market share in agricultural chemicals, herbicides for that matter. The engineering of life science thus was put to the service of sustaining not life (either by reducing hunger or poverty as claimed by the proponents of genetic engineering) but the market life of a chemical. This part of the argument is not new. Second and more importantly, in maintaining its market share, Monsanto's biotechnology did not change the basic parameters of agricultural practices followed before the introduction of genetically modified crop varieties.

Put differently (and abstractly), the introduction of biotechnology in case of Bt cotton did not make any difference in the constellation of ideas, values and techniques that defined the course and nature of technological practice – what Kuhn called "paradigm" and

Richards called "culture" based on the interpretation of Durkheimian sociological theory [Kuhn 1970], Richards 2004]. According to Richards, each technological culture/paradigm has a specific history, collective representation, a material framework, shared values and organisational modalities [Richards 2004].[8] Based on Richards, the technological culture for this paper is understood to mean a material framework, an arrangement, a set of ideas, beliefs, values and attitudes, a particular mode of doing things against which the perceptions and practices of life are pursued.[9]

The technological paradigm of the green revolution (widely adopted prior to the introduction of Bt seeds) could be termed as originating in the cold war era, founded on the values of the efficient extraction of natural resources for the maximisation of output and profit, operated with techniques and artefacts that can maximise that extraction and correspondingly output, based on the collective representation of increasing food security (rightly or wrongly, is the point of debate), and patronised by the public private partnership (the state was the original patron of green revolution but later withdrew to play a regulatory role).[10] Genetically modified crop technology, arguably, shares the same values, material framework and collective representation and therefore strengthens and sustains the green revolution technological paradigm and does not revolutionise it.[11] One of the important aspects of the value framework of green revolution technology has been that any life form springing in the fields, be it plant or organism, that did not increase agricultural production was considered predatory, a nuisance and worthy of total annihilation. Agricultural practices thus were dominated by the use of chemicals that exterminated all life forms not contributing directly to increased production. Genetically modified crop technology fulfilled this specific purpose – made the process of exterminating "predatory" life forms more efficient. Apart from that, the technology did not make any difference in the agricultural and social practices followed in the green revolution-based technological paradigm/(agri)culture and on the contrary perpetuated it, as in the case of Gujarat I would argue later in the paper.

To elaborate further, Monsanto's first line of genetically engineered seeds was tailor-made to tolerate a particular brand of herbicide. It was thus scripted or configured to continue and perpetuate the same paradigm or culture of agricultural practices dominated by chemicals and maximisation of extraction of natural resources in order to increase the output. Monsanto's second line of genetically modified crop varieties, namely, Bollgard and Ingard brands of cotton, with Bt cotton seeds included, also arguably sustained the same technological paradigm/(agri)culture. Apart from facing the threat of losing its market share for herbicide, there was one more reason that was ringing a

death bell for pesticide/herbicide/insecticide-dominated era [Vellema 2004]. The life forms targeted by the chemicals had developed resistance; not only weeds that were supposed to be targeted by the Roundup herbicide, but pests all over the world (including in Gujarat and other parts of India) had become resilient to lethal attacks of pesticides, making them useless in short period of time. In the decade of the 1990s, multinational agro-chemical industries found it increasingly expensive and difficult to bring in new varieties of pesticide or herbicide through the regulatory process [Paul et al 2003]. Instead of spraying the poison from the outside, making a plant genetically lethal to pests was an attractive concept. The incorporation of a lethal gene could then be called "life science", something wholesome and benevolent. However, the knowledge of life science was appropriated to kill un-wanted life forms in the same way as chemicals did in the previous context. Despite the apparent connection with life science, the genetically modified seeds did not revolutionise the basic value framework of the green revolution technological paradigm. Instead of an external spray now the plant itself could bite the pest dead. The rest remained the same, as far as social and agrarian practices were concerned.

However, genetically modified seed technology had one very crucial implication not for farming communities but for Monsanto. Bt technology turned out to be different from its predecessor – hybrid seed technology – in one important way. To produce hybrid seeds two distinct parental lines are needed. Thus only the breeder who has those two parental lines can produce hybrids. The replanting of saved seeds will not grow into a crop resembling the previous hybrid plant but rather perform in an irregular and unpredictable way. Hybrids thus force farmers to buy new seeds every season from the seeds companies. The technology of hybrids thus is non-textually scripted to have a built-in patent; they do not need any regulatory mechanism to ensure that farmers every season buy seeds from the same seed company. Genetically modified seeds (especially of self-pollinating plants) on the other hand can be reproduced easily by farmers and can also be crossed with different parental lines to produce seeds of desired qualities.[12] That means that there is no built in patent in case of genetically modified technology. It therefore requires an external regulatory system to protect the market interest of the seed companies that invest in the development of technology in the first place. Controlling every farmer all over the world through legal and monitoring systems in order to prevent violation of patent is a mammoth task for even the most materially advanced nations such as the US. The task is so mammoth that Monsanto is not trusting state agencies to perform and setting up its own resources to monitor and prosecute farmers.[13]

This crucial (actually lack of) script of genetically modified seed technology has triggered a labyrinth of discussions and controversies all over the world around issues related to the nature of patents and regulatory systems. A technological script could have made this "textual instruction" to ordering and guard moral or ethical behaviour redundant, as in the case of hybrid seed technology. As Latour and Akrich argue technological devices not only perform certain functions, they are also delegated ethics and values that non-textually/non-verbally discipline human behaviour [Akrich 1992]; Latour 1992]. For further discussion on the technical code and script see [Shah 2003].[14]

The non-scripting of genetically modified technology has resulted in the "Bill Gates" of biotechnology keeping (albeit unintentionally) a little window open for the "Robin Hood". "Robin Hood's" arrows apparently look as if they are targeted at Bill Gates, but as I discuss below, "Robin Hood" sponsored Bt technology in Gujarat sustains the same technological paradigm as perpetuated by the global giants like Monsanto.

Bt Cotton Technology in Gujarat

D B Desai, the executive director of Navbharat Seeds Company is lovingly called the "Robin Hood" of biotechnology. There are several parallel stories to account for the travel of Bt cotton seeds to Gujarat via Navbharat.[15] Whatever be the mode of travel of Bt seeds to Gujarat (and for that matter to India), owing to the non-scripting of the genetically modified seeds, only a handful were needed technologically for the massive expansion of cultivation of N-151 seeds in Gujarat. This technological requirement makes the emergence of a "Robin Hood" more plausible.

Tracing the genealogy of the origin of N-151 is less important for this paper. More important is to explain why Bt seeds (originated from generic N-151) are so popularly adopted by farmers. It may be imperative to explain why N-151 seeds are claimed to be performing better (at least in terms of spread if not yield and pest control, although the three are related) than MMB seeds despite the fact that both varieties might have had a common origin. A purely financial and a purely technical reason could be immediately counted. The locally multiplied seeds are generally sold at a lower price than the MMB seeds, although during the peak season even locally multiplied seeds are sold at the price comparable to MMB seeds. On the technical side, after several experiments informally conducted by farmers, the GujCot 8 female line was found to be the most the suitable to cross pollinate with the Bt male line. Farmers claim that the cross pollination of local and global parental lines have produced stable and well-performing progeny.

However, the popularity of N-151 seeds is less a statement against MMB and more a confirmation of the fact that the cultivation of genetically modified seeds has been consolidated. What unfolds is an argument that despite apparent opposition between Navbharat and MMB, the two share a technological culture/paradigm. It looks to me that the more important question is to understand what makes the global and local cross pollinate for Bt technology to find its roots.

To substantiate and further qualify my main argument – the local and global forces joining hands to perpetuate a particular technological paradigm – I intend to discuss three issues with regard to Bt cotton in Gujarat. First, it is important to understand who grows cotton in Gujarat. In other words, who in Gujarat have interest in Bt technology? How do access to land and water and agrarian relations impinge upon the cultivation of Bt seeds and Bt cotton? In other words, in what way does the culture of Bt technology relate to the culture of green revolution technology that may have enabled the adoption of Bt seeds? Second, what are the social conditions that lead to the multiplication and diffusion of Bt cotton seeds? How does globally developed technology finds its local roots in the absence of official market channels? The third important question is not discussed in this paper due to lack of space, namely, what is the contending technological culture/paradigm to Bt technology and how is it that Bt asserts its hegemonic superiority?[16]

Who grows cotton and who has interest in Bt cotton technology in Gujarat? In order to establish that the dominant agrarian section of Gujarat has interest in the technological development around Bt cotton, I need to take a detour and also bring in nature's agency in the frame of analysis. I have adopted Gidwani's two mechanisms (actually four as he elaborates), namely, the "nature of work" and "work of nature" to understand technological change around Bt cotton. The mode of employing labour in the social space is what Gidwani calls the nature of work; nature's subsidy and its unpredictability are counted in the work of nature [Gidwani 2001].[17] I have employed the framework to decipher technological change pertaining to cotton cultivation. What I attempt to argue here is that nature's agency makes cotton cultivation a risky and uncertain enterprise to the extent that the nature of work needed to compensate could potentially be afforded by those mighty enough, historically, socially and materially.

A brief history of cotton is pertinent to establish the nature of the (handi)work of nature. Cotton is one of the oldest crops cultivated in Gujarat, grown for centuries and more so since the colonial times. The native variety of cotton (called Desi cotton) was largely grown in Gujarat before the American variety was introduced in the late 18th and the early 19th centuries to suit the machines of emerging mill

production in the Britain.[18] In the 1960s and 1970s, with the introduction of the green revolution, hybrid varieties developed from the American family (hirsutums) of cotton made pure Desi (arboreum and herbaceum) varieties almost obsolete, although some hybrid were developed by crossing the American seeds with the Desi.

The transition from Desi to American cotton has proven disastrous for the balance of micro-organisms in the local environment. With the American cotton came American Bollworm whose menace has been rampant after the hybridisation and large-scale introduction of pesticides. The history of cotton cultivation in Gujarat is replete with several cotton varieties appearing and disappearing with high speed in order to compensate for, among other things, the pest attack and keep the yield high. Since the decade of the 1970s, hybrid varieties have been introduced to improve mainly yield, which apparently slacks after cultivation for roughly five to seven years.[19, 20] The series of hybrid seeds were also accompanied by the introduction of a series of new pesticides. New cotton varieties and pesticides are continuously invented to counter the work of worms.

Apparently the American organisms have not been very impressed by the American killer chemicals, nor even by new cotton varieties. All through the history of cotton hybridisation, pests showed capacity to develop resistance within a few years.[21] [22] By the mid to late 1990s, pesticides started to account for 40 to 50 per cent of the total cost of cotton production. The new brands of pesticides have become exorbitantly costly even for wealthy farmers. Moreover, nearly half of the country's total pesticide consumption is believed to be used for the protection of cotton crop [EPW 2001]. In fact, pests have not only become resistant to pesticides but on the contrary have been mounting a militant resurgence (technically known as abnormal increase in pest population) requiring even stronger pesticides.[23]

Worms are one type of actors in nature's drama. Access to land and water is also most crucial to growing cotton. Access to land to a large extent is historically determined. Due to the historical advantage received during the colonial period, patels are now economically and socially a dominant agrarian caste in Gujarat.[24] Arguably, access to land is historically determined. Access to water in north Gujarat where cotton is a dominant cash crop is determined on the other hand through control over tubewell technology. Hardiman (1998) shows how the history of ground water extraction has favoured the capital rich farmers.[25] Prakash takes Hardiman's argument further to show that the current scenario also favours wealthier section of agrarian society who have access to groundwater.[26] No source of water means no cotton cultivation. In my own rapid appraisal of

several cotton growing villages in Gandhinagar district I also found that only well owners largely from patel and thakore castes of landowners grow cotton. Farmers without an ownership share in the tubewell would rarely grow cotton.[27]

The risk involved in cotton cultivation generated due to the (handi)work of nature on two accounts – pests and water – is substantial; there is a need for considerable social and material resources for these to be mitigated. However, I would also like to mention that detailed anthropologically oriented studies would be needed to counter or consolidate this argument. The purpose of this paper is to present prima facie evidence about the alliances between local and global elites in building and sustaining a particular type of technological paradigm/culture. I am also acutely aware that my argument is conjectural.

How do cotton-growing farmers counteract the double attack of nature – rapidly resistance-developing pests and fast declining water table?[28] It is through three means that the patels have been able to retain their supremacy: (1) access to labour surpluses, (2) a well developed social network that also functions as a credit network, and (3) diversification of livelihood through out-migration to distant places (first to east Africa and now to Britain and the US). Out-migration of the patel community has not been discussed in this paper in detail.[29] Access to labour and social networks are discussed below.

Social conditions for multiplication and sale of Bt cotton seeds: Access to labour surpluses and dependable social and credit networks enable patels to ensure the cultivation of cotton and multiplication and sale of Bt seeds.

According to a widely believed report, cotton cultivation was reduced by almost 75 per cent in the last few years of the decade of 1990s due to pest attack and water scarcity. Navbharat's N-151 seeds were discovered around the same time. In the villages in Gandhinagar district, from the year 2000 many farmers started to grow Bt cotton as well as Bt seeds. Following are the few key points that emerged from my discussion with the farmers of this area.

N-151 has now become a generic name. In the name of N-151 a range of brand-named seeds are grown and sold. Gandhinagar being the district where plotting of hybrid cotton seeds has been traditionally carried out, Bt seeds are also widely plotted. There are two main channels through which seed plotting and selling is conducted. Gujarat seems to have roughly 500 seed companies, a good number of them give contracts to farmers to multiply seeds.[30] In Gandhinagar district, however, much of the seed multiplication and selling nowadays is done by the farmers themselves. What is important to note here is that neither farmers nor seed companies buy Bt male seeds anymore. They are multiplied by self-pollination.[31, 32]

Apart from the availability of parental lines, access to skilled labour is the most crucial for seed plotting. Seed plotting of hybrid varieties is traditionally and widely done in north Gujarat. The multiplication of Bt seeds has been possible, including experimentation around finding the right type of female parental line, because of the availability of (seasonal) migrant Adivasi labour skilled in conducting cross-pollination. Adivasis entered the village economy more prominently since the 1970s, especially after the intensification of agriculture in the era of the green revolution [Patel 1992]. They now perform a variety of seasonal agricultural tasks. The easy availability of migrant labour in this area is also due to the fact that highly commercialised agriculture is followed. In the area under study, skilled Adivasi labourers are available as commercial plotting of seeds is followed on a large scale. For the seed plotting only seasonally migrating Adivasi labourers and that too young female labourers are nowadays preferred.

The social process of acquiring Adivasi labour and norms and practices followed for plotting hybrid seeds have largely been retained for the plotting of Bt seeds.[33] Easy access to skilled labour has made it possible for cotton-growing farmers to invest in the development of stable and well-performing Bt seeds in a relatively short period of time.

The diffusion of thus grown seeds also exploited existing social networks which also traditionally function as credit channels. During my discussions, farmers repeatedly invoked channels of trustworthiness and known people through which all transactions for the sale of seeds happens. The seller does not go out looking for buyers – that buyers come looking for a known and trusted seller is the philosophy on which the market of locally multiplied N-151 seeds seems to be operating. The question such as "where do you buy your seeds from and whom do you sell your seeds to" were uniformly answered "to and from known and trusted people" (please note that to be known is a prerequisite to be trusted and to be known largely means to be from the same group and social network). Furthermore, as one farmer philosophically explained the logic of market, "je vyapari chhe te ja agent cche ane te ja khedut cche" (the merchant, agent and farmer all mean the same). This little aphorism rightly represents the overlapping of agrarian and market relations with respect to cultivation of cotton. The merchants and agents dealing with cotton and farmers growing cotton not only professionally overlap each other's space but also share caste and kinship relations. Being trusted and known in the community thus goes far in generating not only a creditworthy market reputation but also an acceptable social identity, which would have its own bearing upon marriage and other customs. The market as such is hardly operated on impersonal contractual relations among farmers. It has always functioned through the relations of kin and caste. In the absence of open market space available to N-151 seeds, as they are

declared illegal, the already well-formed social cum credit cum market network has been readily available for the diffusion of locally multiplied Bt seeds.

The social/credit network in the service of the diffusion of Bt seeds seems to be thriving on the effervescent sense of solidarity and communitarianism, which were sustained through a common language of representation and understanding. It was no surprise that many cotton-growing farmers in the periphery of 50 km spoke the same language with the same idiom and expressed similar opinions. It was widely believed that MMB seeds had totally failed. No one knew the exact incident of such failure as MMB seeds have barely been sold in this area. The generic N-151 being locally grown and sold through formal and informal channels on the other hand won the praise of being miracle seeds. Furthermore, going by pure science, locally grown N-151 seeds should have been protected only from American Bollworms and farmers themselves are also aware about this part of the science; still I popularly heard that locally grown Bt seeds have not been infested by either sucking pests or by pink worms or by spotted worms. They do not need any pesticides is what I was repeatedly told although, time and again, one may hear a feeble voice in the group trying to claim that his Bt cotton was infested by white fly or by sucking pests. The control achieved on the most damaging American Bollworms perhaps sustains a complacent sense of “the battle is won” kind of solidarity.

The social channels also performed as conduits for the exchange of knowledge. Locally grown N-151 seeds are now popularly multiplied and grown but only after several experiments informally conducted by farmers. It was part of the common repository of popular knowledge that for producing new seeds, the Bt male parental line is essential but not the key, and that the female parental line determines the performance and stability of the new seeds in the specific agro-ecological conditions in Gujarat. I was told that after experimenting with several locally available female seeds in the last three to four seasons, finally farmers had settled on the female of GujCot 8. GujCot 8 female crossed with the multinational Bt male is what has produced the most stable and miracle progeny and is the latest in the local variant of agri-imperialism. The social conduits of knowledge transfer also produced an interesting discourse on the nature of Bt gene. In response to the question of “whether the Bt effect would gradually reduce in the new generation of seeds, if multiplied in this fashion” farmers described Bt as akin to cancer, “once you get it you can’t get rid of it, it becomes part of the anatomy” was one kind of answer. “Bt male” was often put on the pedestal of immortality – it was claimed to be not ageing, almost ethereal. Farmers believed that if allowed to self-pollinate without any contamination Bt male’s genetic capacity would last forever. With these various discourses forming the backbone of solidarity, the seeds themselves remained

in vogue, in circulation; they were multiplied and sold.

This triumph of local solidarity and social networks in generating locally suitable and adaptable new knowledge and creating alternative channels for its diffusion was too compelling to make the interpretation that local farmers have been successfully contesting multinational monopoly. That farmers have successfully challenged the regime of contract through social contacts was too tempting an interpretation. However, such a conclusion can be sustained only until the social location of the network and solidarity is understood.

This social solidarity also reflects in the way its fraternity (I am consciously using a malevolent term) thinks about the possible implication of widespread Bt cultivation for environmental sustainability. It was commonly acknowledged that the cultivation of Bt cotton extracts extra nutrition from the soil and continuous cultivation for four to five years is likely to leave the soil unfit for any other crop. That Bt cotton needs more water than hybrid varieties is also a common view. Many farmers were almost certain that pests would soon become resistant to Bt seeds. It was popularly believed that after several years of cultivation Bt seeds were no more yielding in China. Farmers also speculated that Bt seeds would perform in Gujarat also only for four to five years. My anxious question “then what?” was almost always answered with an unabated sense of optimism. “What else? Something else will emerge”, “like Dr D B Desai of Navbharat, someone else will come along”, “scientists would come up with some different research”, “as such cotton was stopped [from] being cultivated, as long as we could cultivate it, it would be fine” are the range of responses I received. Farmers have reasons to believe in the miracle of science as this has happened several times in the past. When desi varieties gave only 20 to 30 kg per hectare, the hybrid varieties increased the output by 10 times. Every variety of hybrid cotton with slackened performance was followed by a new variety. If dug wells could not provide enough water, then came electricity and the miracle of tubewells, so followed a train of pesticides and chemicals to keep up the yield. This invincible march of science and technology has happened in the lifespan of farmers in such a way that a kind of optimistic fatalism is bred among them. The farmers have fair reasons to believe the fairy tale of science and technology. The occurrence of “ethereal Bt” is very real for farmers. That scientists and science will continue to protect their interest is the faith that cements the solidarity of wealthy and dominant farmers of Gujarat. On this faith the technological culture/paradigm finds its roots and spreads its hegemonic canopy.

In short, the previous discussion attempts to bring the point home that the popular multiplication of Bt seeds and cultivation of Bt cotton shows a rather smooth insertion of the genetically modified technology in the existing social

and agrarian space that is dominated and shaped by the practices of green revolution technology.

Points for Further Discussion

Vishvanathan and Parmar (2002) in their lengthy corollary argue that biotechnology has become a site for wider debates of the democratic imagination in India. Biotechnology debate has been "turned into a morality play, a social drama of positions, a circus of spectacles, epistemologies…" so depict Vishvanathan and Parmar. This sounds not unlike the table thumping that Geertz (1988) describes at the end of his book *Anthropologist* as Author: "…someone shouts indignantly, 'Where are the facts?', the other shouts back, 'No, where is the question of power?'…" The biotechnology debate in India is sailing majestically between these never meeting shores of "facts" and "question of power". It is also focused largely on taking positions in favour or against genetic engineering and putting demands on the state for mediating and regulating. This paper is in fact an addition in the drama around the democratic imagination of biotechnology. Here are few points that I would like to raise in the spirit of provoking further "textuality" – debate.

(i) The paper wants to bring to the core of democratic imagination, overfilled with the plurality of voices and texts, the point that while the communicative rationality of the public sphere is "textually" debating the good and bad of genetic engineering, the technological culture, with its non-textually inscribed rationality, is ideologically conditioning and shaping the direction of action in a hidden and subtle way. I almost compare rationality of technological culture with political rationality (in the sense of Foucault's governmentality).[34] Technological culture, with its inscribed rationality, thus operates in such a way that power works through it by structuring the possible field of action, so as to oblige it to take the desired direction.

Genetically modified crop technology – its rationality inscribed (intentionally or unintentionally is a point of debate) with ideas, values and framework – belongs to the technological paradigm of the green revolution. The development and diffusion of Bt seed technology by farmers themselves implies that the technology finds a smooth insertion in the social and agrarian space shaped by the technological culture of green revolution. Technological culture thus both constitutes and creates the configuration of social space in the context of which certain practices are followed. The success of Bt seeds implies that genetically modified technology has not caused any paradigmatic shift around technological practices. In fact, genetically modified technology as a solution to the problems generated in the green revolution technological paradigm has sustained and reinforced the hegemonic supremacy of global and local elites.

(ii) The answer to the question of why Bt seeds are popular

among farmers and why the technological paradigm of integrated pest management is not commonly adopted by cotton growing farmers has to do little with rationality as such. The choice of technology is hardly about the technological rationality that impinges upon the issues, such as what works and what does not work. Technological rationality in that sense is indeterminate until it is inserted in the social space. In other words, whether integrated pest management methods rationally work or not is hardly an issue. Why integrated pest management has not been popularly practised by farmers, compared to the phenomenon of the multiplication of the Bt gene, is less a question about technological rationality and more an issue pertaining to the location of technology in social space.

(iii) A related point is what has been indirectly discussed in the paper. Knowledge development pertaining to Bt cotton technology in the globalised world has been multipolar. Multiple global and local actors have joined hands in developing and diffusing the knowledge on Bt cotton seeds. However, multipolarity of knowledge generation does not necessarily entail technological multiculturalism as the case of Bt technology explains. Neither does it ensure automatic democratisation as a result of the involvement of the political agency of the local. The multipolar development and diffusion of knowledge with local political agency playing an important role in this process, can still mean the monoculturalism of technology. It has certainly not been the case that Monsanto advocates Bt technology while farmers in Gujarat resist Bt and adopt integrated pest management. Looked at from the lens of monoculturalism of technology, the global and local distinction in terms of the distribution of power poses a problem. The popularity of Bt cultivation in Gujarat shows the triumph of the technology supported by both the global and local elite.

(iv) Farmers are often characterised in the current academic discourse as playing either of the twin roles ascribed to them. They are either largely assumed to be victims of the processes of globalisation (a rather sympathetic and passionate view prevails in academic circles that the processes of globalisation and liberalisation have left farmers vulnerable in such a way that they have no options but to commit suicide) or seen as burdened with politically correct agency (often the narration of thousands of farmers flocking the streets opposing WTO and seed monopoly is given discursive space that obliterates and obscures all the contradictions that lie behind farmers' movements in India). At least Bt cotton-growing farmers in Gujarat are neither passive victims of globalisation and liberalisation, nor are they agents of democratisation. The case of adoption of Bt technology shows that local elites have political agency that joins hands with global elites in perpetuating technological monoculturalism.

(v) Lastly, Wittgenstein once said that rule making is integral to a specific and shared form of life and various social groups have incommensurable worldviews. The tragedy of the current agrarian scenario is perhaps that the

hegemonic domination of the "rule making" of the technological paradigm of green revolution remains largely uncontested. In the end, I boldly propose that the incompatibility of a technological culture such as integrated pest management with the dominant hegemonic paradigm of the green revolution could potentially inaugurate a different social space and thus herald a process of democratisation. As Richards (2004) also partly argues, multiculturalism of technology, wherein different technological paradigms thrive and vie for supremacy, could potentially lead to the road of democratisation.

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Notes

[I would like to thank the farmers of Gandhinagar district and the staff and owners of several seed companies for sparing time and interacting with me. I am acutely aware that the conclusions in my paper are not going to match with their views. I only hope that they would be able to appreciate the academic tradition of debating, which I hope to continue practising even in my future interactions with them. I also take the opportunity to thank Edwin Nuijten for cross-checking and correcting the plant breeding part of the paper and also for his comments. My thanks also to the participants of the conference on Agricultural Biotechnology (organised by the Centre for Regionalisation and Globalisation, Warwick University, March 12-14, 2005, in which this paper was first presented) for their interest in my paper and for their comments. Finally, I thank Harro Maat for his moral and intellectual support for this project.]

1 Bt cotton incorporates a gene Cry AC 1 from a soil bacterium called Bacillus thuringiences (Bt) which provides protection against American bollworm.

2 However, it is reported based on a survey of 363 farmers conducted in the year 2000 in Gujarat that MMB seeds gave the highest yield [Gupta and Chandak 2004].

3 Two letters submitted to Manju Sharma, secretary, department of biotechnology, dated October 5 and October 12, 2001.

4 According to the survey of 650 farmers conducted by J V Shah (as published in Diwya Bhasker, January 11, 2005), 128 farmers cultivated illegal Bt varieties for more than three years, 305 farmers for two years and 217 farmers for one year.

5 Based upon Mehta and Patel (2004) and personal interview with staff and owners of seed companies.

6 Farmers of Gujarat have also made more demands. By shooting green worms dead with the Bt weapon and blessed by the rain god, the farmers of Gujarat have flooded the market with cotton. As a result of overproduction the market price of cotton has fallen. Organised into the Bharatiya Kisan Union (BKU), the farmers of Gujarat are now asking for the central government to intervene, increase the support price and discourage import of raw cotton by increasing the duty from 10 to 40 per cent. Massive rallies have been organised in different parts of Gujarat by BKU (that claims to make or break governments) in alliances with other political parties in the months of December 2004 and January 2005, and which were still going on when this paper was being written.

7 The sale of herbicide Roundup supported Monsanto's early investment in biotechnology in the 1980s. The first line of genetically engineered crops such as soybeans and canola produced by Monsanto were made resistant to its herbicide – Roundup – to increase the sale of the herbicide. Meaning, the insertion of the gene from a micro-organism made these plants resistant to the direct spraying of Roundup herbicide, which then could be freely sprayed to control weeds and pests. Genetically engineered Roundup ready varieties of Monsanto had huge success in the market (especially in the US, Canada and Argentina) which perpetuated a Roundup dominated regime of cultivation, though not

without contests and protests from green activists and farmers' organisations. Notwithstanding the protests, under Shapiro's leadership, biotechnology provided Monsanto an opportunity to sustain its large market share in the sale of herbicide. The turning point in this monopoly-oriented cropping regime arrived close when the patent on the active ingredient in Monsanto's biggest profit-maker – herbicide Roundup – was coming to expire in the year 2000. By this time Monsanto had already developed its second line of genetically engineered insect resistant crop seeds – Bollgard and Ingard brands of cotton and also insect-protected corn and potato [Paul et al 2003]; [Vellema 2004].

8 Technological culture and paradigm are discussed in more detail in the longer version of this paper submitted to the working paper series of the Centre for Regionalisation and Globalisation, Warwick University, UK.

9 The notion of technological paradigm thus employed in this paper has come far away from the original notion worked out by Giovanni Dosi [Dosi 1984]. The reworked notion not only places genetically modified seed technology in the context of global and local political economy but also gives an opportunity to evaluate how its perceptive and material frameworks configure actions of the agents who design and use the technology. Based on this notion of the technological paradigm, it is argued in the paper that genetically modified seed technology does not imply a new technological paradigm. In fact, in terms of the global and local political economy of agriculture, in terms of the values and social practices followed around agricultural technologies, and in terms of the operation of global and local power, genetically modified seed technology did not introduce radical changes or major discontinuities. The answer to the question of why farmers of Gujarat popularly adopt genetically modified Bt seeds lies in the further explanation of this argument.

10 Based upon Richards (2004).

11 Here the reference in my discussion is only to genetically modified crop technology, and not the entire science of biotechnology. Some people consider the science of biotechnology as a change in paradigm speaking strictly from a scientific point of view. However, my argument is based on the one forwarded by Russel who would evaluate technological paradigms in the context of global political economy and not in the narrow framework of science and technology developed in laboratories [Russell 1999]. This point is elaborated in the larger version of this paper submitted to the working paper series of Centre for Regionalisation and Globalisation of Warwick University, UK.

12 To describe the specific case of Bt cotton in more detail, varieties such as N-151, Mech 12, Mech 162, Mech 184 are produced by crossing a genetically modified male line with a local (usually hybrid) female line. A genetically modified Bt gene inserted male line was originally produced in the laboratories of seed industries like Monsanto. Once the gene is inserted, seeds can be replicated reasonably well by self-pollination or open pollination (in the case of cross-pollinating crops like cotton). When the Bt gene inserted male line is crossed with the female line Bt cotton seeds are produced (farmers claim to be able to retain 95 to 98 per cent of the original genetic capacity in thus produced seeds).

13 The Centre for Food Safety (CFES) just released a report detailing Monsanto's lawsuits against American farmers. CFS notes in the report that, to date, Monsanto has filed 90 lawsuits against American farmers in 25 states that involve 147 farmers and 39 small businesses or farm companies. Monsanto has set aside an annual budget of $ 10 million dollars and a staff of 75 devoted solely to investigating and prosecuting farmers. A copy of the report can be downloaded from http://www.centerforfoodsafety.org/Monsantovsusfarmersreport.cfm

14 It would be important to mention here that Monsanto did try to script the genetically modified technology in such a way that the mammoth task of monitoring and regulating to protect proprietary rights and profits becomes redundant. It has been described as Genetic Use Restriction Technology (GURT) which international activist organisations have named as terminator seeds. By scripting the technology in this way the entire gamut of tasks granted to regulatory and monitoring mechanisms would have been performed by one gene. Once inserted, the gene would ensure that the seeds lose their germinative capacity and hence cannot be multiplied either through self-pollination or open pollination.

Worldwide protests against such a move finally made Monsanto abandon the plans at one point of time [Vellema 2004].

15 Navbharat and also Gujarat Seed Producers Association in their recent declaration claim that N-151 seeds were developed through the process of conventional breeding [Mehta and Patel 2004]. It is claimed that Navbharat Seeds experimented with the germ plasma conventionally collected from the cultivators' fields and through the conventional methods of breeding developed N-151 seeds. What is argued is that the germ plasma did not show any sign of Bt gene, neither was the company aware of the existence of such a gene in the newly developed hybrid seeds and thus nor did it apply for the approval from GEAC. Navbharat further maintains that no genetic engineering technique was applied in the development of its cotton seeds given that the company had no facility to undertake such scientifically complicated tasks [Mehta and Patel 2004].

16 The point that farmers have not adopted the technological paradigm of integrated pest management in the place of Bt technology has been discussed in the version submitted to the working paper series of Centre for Globalisation and Regionalisation, Warwick University.

17 Gidwani employs these mechanisms to account for agrarian change that combines pure determinism and pure contingency variances. Unfortunately though, Gidwani's mechanisms have prominent space for nature, technology in his conception appears peripherally. All those aspects that belong to the physical landscape Gidwani has subsumed under the category of nature, obliterating the need for technology to transform nature through work.

18 The debate about the merits and demerits of American and Desi cotton is now a well known part of colonial history [Prasad 1999]. The American varieties had longer filaments, were hence more suited to the machinery in Europe and thus encouraged by the British even when they were highly susceptible to pest attack as compared to the Desi type. The older generation of cotton growing farmers still remembers the quality of Desi cotton, which is considered completely resistant to pest attack. The American varieties were first introduced in India as early as the 1790s and the experiments and discussions continued almost until the end of the 19th century. By the early 20th century, American cotton had significantly replaced the Desi varieties [Prasad 1999]. However, in Gujarat, Desi varieties were continued to be grown until the 1950s and 1960s. It is with the advent of the green revolution that cultivation of Desi varieties became uneconomical as they were unsuited to increase in yields through artificial inputs such as fertiliser.

19 Based on my discussion with cotton growing farmers of Gujarat.

20 First, a hybrid variety known as GujCot 4 or H-4 (popularly known among farmers as Sankar 4, Sankar literally means hybrid) was introduced in the early 1970s, which gave, as farmers described, super bumper yields in the beginning but then was massively infested with pests within five to seven years. In the meanwhile, a short-term variety GujCot 8 (Sankar 8) was introduced, which could be reaped in four months time (instead of the six months duration of Sankar 4) making it possible to cultivate three crops a year or grow one more food crop after the harvest of cotton. However, even GujCot 8 was heavily infested with pests, which was followed by GujCot 9 and 10. ("And so it goes on" my informant farmer optimistically concluded.) Even after the introduction of GujCot 8 and 9, GujCot 8 remained popular until the late 1990s when it was repeatedly and massively attacked by American Bollworm.

21 The cotton plant is infested by various types of pests. The most devastating among all is American Bollworm (heliothis and helicoverpa armigera). There are also others: tobacco caterpillar (spodoptera litura), whitefly (bemisia tabaci), pink bollworm (pectinophora gossypiella) and spotted bollworm (earias vitella) [Shetty 2004].

22 It is widely reported that the threat of American Bollworm reached catastrophic levels in the late 1990s, potentially causing several farmers in Andhra Pradesh and Punjab to take their lives [Bose 2000; Prasad 1999]. The farmers of Gujarat whom I interviewed told me that they used a cocktail of pesticides to control different types of pests and even targeted different stages of development of pests but often without any results. Usually 10-12 sprayings and a maximum of 15 sprayings of pesticides are recommended but, since 1996, pests seem to not be affected even after 30 sprayings a season (also corroborated by reports

from other parts of country) [Shetty 2004].

23 The productivity of cotton dropped as a result to half from roughly 550 kg/hectare in the early 1990s to 300 kg/hectare in the late 1990s [Shetty 2004].

24 During the colonial period, kanabis (a peasant caste/community) being sedentary cultivators, as against kolis (another peasant caste/community) being shifting cultivators, were elevated into a category of landowners called patidars (literally mean those who have formal ownership right over a piece of land) [Shah and Rutten 2002]. Through the change in the land tenure system during the colonial period, kanabis encroached upon the land until then cultivated by kolis and tribals [Rutten and Patel 2002; Gidwani 2001]. Since the early to mid-19th century kanabis – who eventually got recast into patels – economic and political power steadily ascended. "Patel" was originally a title given to a village officer in charge of tax collection and law and order. The title was now adopted by all members of the kanabi alia patidar caste/community [Gidwani 2001].

25 Although the British considered cotton a non-irrigated crop, Hardiman argues that in the past cotton was always watered with wells to raise the yield [Hardiman 1998]. The current varieties of cotton also need at least 8-10 and 12-15 irrigations for good yield. A large part of mainland and north Gujarat – the cotton growing tract – with arid and semi-arid climate, and surface irrigation concentrated in southern Gujarat – is dependent on groundwater [Prakash 2005]. The British policy on groundwater extraction was so designed that only wealthier cultivators could afford to dig a well in the first place and pay an exorbitant amount of tax levied on it as well. Later, the policy gave exemption in tax to deeper wells that also favoured capital rich farmers who could afford to dig deeper wells.

26 In Prakash's study village, patels own 53 per cent of total village land and 67 per cent of the total number of wells [Prakash 2005]. Although a majority of [atel farmers of Prakash's study village fall in the category of marginal, small and medium farmers, their capital share in tubewells (65 to 67 per cent of total number of tubewells in the village) give them decisively larger share in the access to groundwater which is available at more than 1,000 ft. Prakash further shows that the extent to water market that provided an opportunity to non-tube well owners to access groundwater in the past has declined in the last five years or so as a result of reduction in the electricity supply. When water is not enough even for the shareholders in tubewells, there is not much left for selling it to the non-shareholders.

27 Usually one tubewell can supply water to 30 bigha of land (1 bigha is 24 gunta and 40 gunta is 1 acre) given the electricity supplied is only for eight hours. Usually one tubewell has five to six shareholders, they get a share in the water depending upon their share in capital investment. Excess water is sold to non-shareholders although this has currently become rare. If excess water is available, one hour of water supply costs anywhere between Rs 80 to 120. One bigha needs eight hours of water supply and cotton needs water every 12 to 15 days, buying water even if it is available becomes a costly affair.

28 See Prakash (2005) for a larger discussion on the groundwater scenario in Gujarat.

29 See [Rutten and Patel 2002] for further discussion on out-migration of patels to Africa and Britain and for a similar argument see Prakash (2005).

30 Two types of seeds known as foundation seeds – 240 gm of Bt male and 600 gm of hybrid female (usually GujCot 8) – are supplied for one acre. One acre can produce anywhere between 100 to 300 kg of seeds.

31 One farmer described that he first plotted Bt seeds in the year 2002 but not knowing that he could save his own Bt male seeds, he cleaned up the farm. Next year he bought Bt male seeds from the local merchant/agent and multiplied it through self-pollination for the next three years. He now keeps a stock of Bt male seeds and multiplies them easily through self-pollination. He has to buy GujCot 8 female seeds every year from the market to cross with Bt male seeds. In the year 2000, Bt male seed was available at the cost of Rs 10,000 for 60 gm which now is reduced to Rs 3,000 to 4,000.

32 Seeds are plotted in the month of May or June and it is usually after 45 to 60 days that crossing starts and then continues until 120 days.

33 Usually an agent is contacted and given an advance by the seed

plotter to procure Adivasi labourers. The agent brings the (young female) labourers for seasonal employment for two months. The landowner provides staple grains and sometimes vegetables for their subsistence, the cost of which is subtracted from the final payment. Roof and water are provided in the field, fuel for cooking is given free and in addition Rs 40 to 50 is paid to the agent towards the daily wage. The agent pays the labourer after cutting his own commission. The labourers live in the field usually under plastic sheets in the monsoon months – the season for plotting – and are expected to work between sunrise and sunset to follow the natural cycle of pollination. Days of heavy rain make it difficult to work. No work, whether rain or shine, means no payment.

34 The notion of political rationality in which power works by constructing normatively inscribed free social space and constructing subjectivity that Foucault called governmentality.

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