GENETICALLY MODIFIED COTTON:
AGRARIAN DISTRESS AND INDIA'S EMERGING ECONOMY

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GENETICALLY MODIFIED COTTON:
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Farmer suicides were first reported in Vidharbha, eastern Maharashtra, a prominent cotton growing region in India in 2005. Similar farm crises that came to light in other cotton regions and rainfed India shocked the sensibilities of the policymakers and public alike. Simultaneously, in 2002, genetically modified (GM) cotton or Bt (*Baccilus Thurigenesis*) cotton, produced by agro-transnational corporation Monsanto, was introduced and adopted widely in Vidharbha and India's cotton belt. Even before their official release, "illegal" GM seeds were found growing in the central-western state of Gujarat, another prominent cotton growing region in 1998. GM cotton and GM crops are proposed to increase agricultural productivity and usher in a "second Green Revolution" or Gene Revolution in Indian agriculture.

The 1960s Green Revolution is widely considered to be an important milestone in changing the face of Indian agriculture as it helped raise agricultural yields, increased agricultural incomes, and saved India from a food crisis. The Gene Revolution is posited to be that imperative sequel to the 1960s Green Revolution that will transform the state of agriculture in rainfed areas. What were the effects of the Green Revolution in Vidharbha and in rainfed areas of India? What impacts does the introduction of GM cotton have on farmers' livelihoods in Vidharbha? Will the use of GM cotton lead to positive gains in Vidharbha just as the use of Green Revolution technology did in irrigated areas of the country?

In reality, the Green Revolution failed to raise the incomes of farmers in Vidharbha and in rainfed areas of India. By comparing the process of gains that

farmers made during the Green Revolution with the Gene Revolution, this dissertation argues that first compared to the winners of the Green Revolution, the economic and ecological capabilities of cotton farmers adopting GM crops in Vidharbha are poor. Second, a supportive "policy and institutional" infrastructure does not exist for the adoption of GM technology in Vidharbha. Such state support allowed the agricultural production process to become safe and profitable only for rich and middle class farmers during the Green Revolution. Third, post trade liberalization, the increasing exposure of the domestic economy to trends in the international trade of raw cotton and textiles, can affect cotton farmers' income negatively. As a consequence, GM cotton or the Gene Revolution will be unable to alleviate the crisis condition of cotton farmers. Government intervention is needed to provide cheaper or alternative technologies, such as introducing public sector Bt cotton, Integrated Pest Management or organic farming practices, as well as encouraging food farming and creating opportunities for non-farm employment.

BIOGRAPHICAL SKETCH

Asmita Bhardwaj, an Indian national, has been a Ph.D. student at the Department of City and Regional Planning at Cornell University since 2002. Her thesis on the political economy of genetically modified cotton in India was funded by a four-year scholarship and small grants from the Department of City and Regional Planning, the Mario Einaudi Center and the Center for Transnational Contention at Cornell University.

Previous to her affiliation to this Department, she was a Master's student at Virginia Polytechnic and State University in the Department of Urban Affairs and Planning. Besides her doctoral dissertation, she has significant experience working with intergovernmental, governmental, academic and local communities on agricultural and rural development issues. She has been affiliated with the Tata Energy Research Institute (NGO, Delhi, 1999), International Institute of Sustainable Development (NGO, New York, 2005–present), International Institute of Sustainable Development Reporting Services (NGO, Winnipeg, Canada, 2004–2006), United Nations Framework of Climate Change Convention (Intergovernmental Organization, Bonn, 2003), Brookings Institute (NGO, Washington DC, 2007), Virginia Water Resources Research Institute (Academic Institute, Virginia, 2001), Virginia Polytechnic and State University (2001) and Cornell University (Academic Institute, 2002–2009).

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AGRA	Alliance for Green Revolution in Africa
AOA	Agreement on Agriculture
APC	Agricultural Prices Commission
APMA	Agricultural Produce Marketing Act
Bt	Baccilus Thuriegenesis
CGIAR	Consultative Group of International Agricultural Research
CCI	Cotton Corporation of India
CACP	Commission of Agricultural Costs and Prices
C-D Ratio	Credit Deposit Ratio
CIMMYT	International Wheat and Maize improvement Institute
CSE	Center for Science and Environment
CSE-NCF	Center for Science and Environment-National Commission of Farmers
CRIDA	Center for Research in Dryland Agriculture
DPAP	Drought Prone Assistance Program
ELS	Extra Long Staple
FAO	Food and Agriculture Organization
FCI	Food Corporation of India
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GEAC	Genetic Engineering Approval Commitee
GM	Genetically Modified
HYV	High Yielding Varieties

IADP	Intensive Agricultural Development Program
IARI	Indian Agricultural Research Institute
IAS	Indian Administrative Services
ICAR	Indian Council of Agricultural Research
ICDS	Integrated Child Development Scheme
ICRISAT	International Crop Research Institute for Semi-Arid Tropics
ILO	International Labor Organization
IFPRI	International Food Property Research Institute
IGIDR	Indira Gandhi Institute of Development Research
IRRI	International Rice Research Institute
IMF	International Monetary Fund
IPM	Integrated Pest Management
IPR	Intellectual Property Rights
ISAAA	International Service for Acquistion of Agri-biotechnologies
IWMI	International Water Management Institute
KRRS	Karnataka Rajya Ryotha Sangha
MEGS	Maharashtra Employment Guarantee Scheme
MFA	Multi-Fiber Agreement
MFAL	Marginal Farmers and Agricultural Laborers Assistance
MRTPC	Monopolies and Restrictive Trade Practices Commission
MMB	Monsanto-Mahyco Biotech
MRTPC	Monopoly and Restrictive Trade Practices Commission
MSP	Minimum Support Price
NAIS	National Agriculture Insurance Scheme
NARS	National Agricultural Research Systems

NCF	National Commission of Farmers
NPA	Non-Performing Assets
NRAA	National Rainfed Areas Authority
NREGA	National Rural Employment Guarantee Act
NRI	Non-Resident Indians
NCAER	National Commission of Applied Economic Research
NGO	Non-Governmental Organisation
NSSO	National Sample Survey Organization
OGL	Open General Licence
PDS	Public Distribution System
SAP	Structural Adjustment Programs
SEZ	Special Economic Zones
SFDA	Small Farmers Development Agency
TPDS	Targeted Public Distribution System
TRIPs	Trade Related Intellectual Property Rights
TUFS	Technology Upgradation Fund Scheme
TISS	Tata Institute of Social Sciences
UNDP	United Nations Development Program
UNRISD	United Nations Research in Social Development
USAID	United States Agency for International Development
VAT	Value Added Taxes
VOFA	Vidharbha Organic Farmers Association
WTO	World Trade Organization

Chapter 1

THE PROMISE OF GENETICALLY MODIFIED CROPS

Genetically modified (GM) cotton or Bt-cotton (*Bacillus thuringiensis*), produced by the agro-transnational company, Monsanto, has been adopted widely in India's cotton belt. Even before their official release, illegal GM cotton seeds were found growing in the central-western state of Gujarat in 2002. As farmers in Gujarat reaped good returns off the illegal seeds, spurious GM cotton were smuggled into a number of cotton producing states. These states had long been seeking a solution to declining cotton yields. Ever since Monsanto's varieties were officially approved, increasing acreage under Bt cotton has made India the seventh largest adopter of GM cotton in the world (ISAAA 2006).

According to GM proponents, such wide popularity of GM crops necessitates introducing GM crops on a wider basis in Indian agriculture. Also sought is the creation of faster bio-safety trials and GM product labeling regimes.[1] Bt cotton and GM crops are considered crucial to increasing agricultural growth and productivity and will usher in a "second Green Revolution" (Sibal 2005, Singh 2005, Planning Commission: 2006b).

[1] For instance, an International Food Policy Research Institute (IFPRI) workshop titled "Economic Considerations of Biosafety and Biotechnology Regulations" was held on August 24–25, 2006. Another conference was held under the aegis of the think tank Tata Energy Research Institute titled: "International Conference on Agricultural Productivity, Nutritional Security and Rural Growth" on 25–27 May, 2006. A Confederation of Indian Industries Workshop titled "Technology in Agriculture: Growing Farmers' Wealth" was held in December 2006 that showcased the technological developments in food and agricultural sector. Another National Workshop on Management of Field Trials of GM crops was held in Delhi in August 2005 that discussed the modules of standard operating procedures of field trial guidelines.

Technology-led agricultural growth has been embraced as an important strategy by the Indian government. The Approach Paper to the 11th Five Year Plan suggests,

> Technology fatigue is the major cause underlying the deceleration of the performance of the agricultural sector. Since the Green Revolution in the sixties there has been no major technological innovation, which could give fresh impetus to agricultural productivity. The absence of productive technology, which also reduces risks, is particularly serious for rainfed, dry land situations. In the long run, growth in agricultural productivity can be sustained only through continuous technological progress. (Planning Commission 2006b)

Calling for a second Green Revolution, the Plan paper further notes that the supply side of increasing agricultural growth is really formidable. This is especially so because no dramatic technological breakthrough comparable to the Green Revolution is presently in sight.

While GM crops promise a bounty, the situation is critical for cotton farmers and small and marginal farmers in many parts of India. Farmer suicides that were first reported in the cotton regions of Vidharbha, Maharashtra[2] and later in other parts of the country have shocked the sensibilities of the policymakers and public (Misra 2006, CSE-NCF 2006, National Commission of Farmers 2006, Planning Commission 2006a, Mishra 2006). A Situational Assessment of Farmers under the 59th Round of National Sample Survey[3] conducted in 2003 suggests that nearly 49% of the farmer households are indebted, with an average debt of 575.6 USD[4] (Mishra 2006).

[2] In 2005, Ratan Tata, a corporate philanthropist, gave Cornell University, approximately 50 million USD to address problems of cotton farmers in Vidharbha and the agrarian sector at large. Currently, there exists a Tata-Cornell initiative created to address farmer's distress in Vidharbha.

[3] The National Sample Survey is an important statistical document based on accurate government statistics held under the Ministry of Statistics and Programme Implementation.

[4] Rs 25,902= Rs 25,902/45=575.6 USD. 1USD=45 Rs.

What were the effects of the Green Revolution in Vidharbha and in rainfed areas of India? What impacts does the introduction of GM cotton have on farmers' livelihoods in Vidharbha? Will the use of GM cotton lead to positive gains in Vidharbha just as the use of Green Revolution technology did in irrigated areas of the country?

Research Significance

This dissertation is a timely one because cotton is a vital commodity crop for India. It provides a livelihood for more than 60 million people who engage in cotton farming, processing, and cotton textile manufacturing (IFPRI 2008). Given that the distressful farm crisis is not restricted to the cotton crop or cotton farming regions in India, and is more widespread in other rainfed tracts of India (Vaidyanathan 2006), the findings of this dissertation will be important for national policy makers. Globally, the world is facing a food crisis (FAO 2009), which is extremely severe in parts of Sub Saharan Africa. Agri-biotechology-led policies have been posited as a crucial solution to this crisis (FAO 2009). Thus, this dissertation is an opportune one for international policy makers as well.

This dissertation will contribute to the growing literature on GM crops and Green Revolution technologies as tools for alleviating poverty (see for example, Special Issue of Journal of Development Studies 2007, Pinstrup Anderson and Schioler 2006). Given the dissertation's focus on the critical role of state policies and institutions in securing economic gains for farmers, the dissertation may be useful for scholars who are debating the efficiency of state institutions versus the private sector for delivery of important public goods such as rural development, water or environmental solutions (Coclough and Manor 2000, Gore 2000, World Bank 1996).

Finally, this dissertation is also significant for those who study the social impacts of technology (Pinch and Bijker 1987, Latour 2005, Cowan 1976, Berg and Lie 1995).

Argument in Brief

The analysis presented in this dissertation suggests that Bt cotton does not provide as significant a benefit to cotton farmers in Vidharbha as it promises. I develop this argument by revisiting the history of the 1960s Green Revolution. I identify three important conditions under which farmers gained from the Green Revolution technology. These include:

- Initial ecological and economic condition of farmers
- Presence of supportive policy and institutions
- Bargaining power of the farmer movements

I trace the presence of similar conditions in Vidharbha, a distressed region in eastern Maharashtra, where Bt technology was adopted in 2002. I find that cotton farmers in Vidharbha face a number of economic and ecological problems such as uncertain remuneration, water scarcity, and natural calamities, all of which have led to a crisis of the farm economy[5] in Vidharbha. These farmers are not "progressive farmers"[6] of the type that existed during Green Revolution times. It was the better economic, political and ecological resource conditions of these progressive farmers that allowed them to make substantial gains from Green Revolution technology. Second, none of the problems that farmers in Vidharbha and other rainfed areas of India are facing can be solved by Bt technology alone. Third, the kind of "policy and institutional" support that allowed rich and middle class farmers to gain significant economic benefits from the Green Revolution is scarce during the adoption of Bt

[5] Crisis in the farm economy or farm crisis means farmers committing suicides.

[6] See Andrew Pearse (1983) for a description of this term.

cotton. Such a state-supported package allowed the grain production process to become safe, predictable and profitable for the adoption of Green Revolution technologies. Fourth, I suggest that the increased export competitiveness of cotton textiles does not provide any benefits to the cotton farmers. Fifth, I argue that following India's economic liberalization, the farmer movement does not enjoy the same kind of bargaining power as it did in the 1980s. In 1981, a collaboration of farmer movements was able to create a heavily biased national agricultural budget. The environmental movement and the industries with which the farmer movement now allies do not strongly represent the (cotton) farmers' causes, especially for getting social security. As a consequence, Bt cotton in itself will be unable to alleviate the cotton farmer's state of crisis. This dissertation then suggests that cotton farming in Vidharbha has lost its comparative advantage.[7] Therefore, the importance of policy intervention in the form of state support is highlighted for rejuvenating the agrarian economy through alternative technologies or for developing mechanisms for creating non-farm employment for the farmers who want to leave cotton farming.

The factors impacting the economic and ecological life of farmers that need to be considered in order to understand the impacts of GM crops are depicted in Figure 1.1. Figure 1.1 shows that the impacts of adoption of GM crops on the farmers' economic life in Vidharbha are mediated by a number of factors at the local, national and international levels. The local level factors include existing cropping patterns, irrigation coverage, rural banking and credit, agricultural extension, presence of markets, appropriate prices and procurement mechanisms and poverty alleviation programs. At the level of national policies, the economic life of the farmers is affected by government policies towards agriculture, cotton textile policy and the farmers'

[7] Comment, Professor David Lewis, Cornell Institute of Public Affairs, January, 2009.

bargaining power. At the level of international policies, the farmers' economic life is affected by the MultiFiber Agreement (MFA) on textiles. This agreement has been dismantled recently to allow an increase in the textile exports from developing countries into hitherto excluded markets of developed countries.

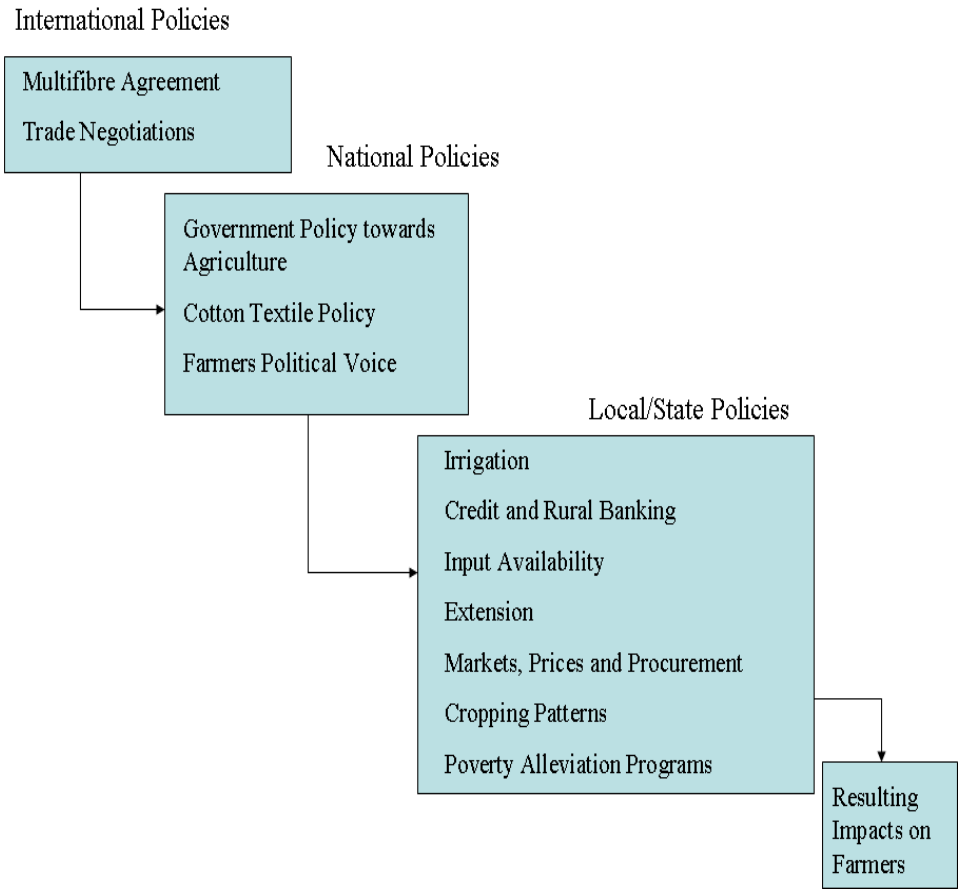

Figure 1.1: Hierarchy of Policy Issues Related to GM Crops

Source: Author

Research Experience

I began my dissertation by asking a very different research question. Having taken several classes at Cornell in international political economy and international environmental issues, I wanted to examine the negotiation process for market based

mechanisms in the climate change negotiations. My work then graduated to comparing the politics of the Climate Change Convention and the Biosafety Convention. Finally, I wanted to focus on the politics of adopting GM technologies and the technologies' impacts on farmers. Most of the internet literature and academic debates that I encountered in the United States focused on the environmental effects of GM crop technology or its economic benefits. Debates at Cornell, most prominently led by Professor Ron Herring of the Government Department, addressed very convincingly the problematic framings of the risks of GM crops as elaborated by anti-GM activists like Vandana Shiva. Many other Cornell scholars, such as Professor Pinstrup-Anderson, an agricultural economist, asserted that GM crops were necessary for developing countries such as India and that western or city-based activists who knew little about rural life should not block their adoption. Citing the experience of the central-western state of Gujarat, they argued that farmers had full faith in the new technology and their acceptance showed its clear-cut benefits. I had read about the status of Indian agriculture on the internet before coming to the field. This research provided me with a different view of the farmer's situation than what was being discussed in the GM conferences.

Entering the Field: In my preliminary studies undertaken in the summer of 2005, I had met researchers who were working on GM crops. Some were located at the Pusa Institute of Delhi, where the Consultative Group of International Agricultural Research (CGIAR) and National Agricultural Research System (NARS) centers are located. I attended policy conferences relating to GM crops in Delhi. I soon discovered that there was a common theme to these events. Large-scale conferences on GM crops hosted by international institutions and the seed industry discussed agrarian issues in terms of increasing agricultural productivity through technological breakthroughs such as Bt cotton. Quantitative estimates of how Bt cotton and GM crops have and can

reduce pesticide use and increase profits were discussed in the glamour of expensive hotels in the capital city. In these surroundings, it was difficult to imagine that there was a farm crisis[8] brewing in the countryside. The farm crisis was first discussed in a few newspapers when a large number of Indian dailies shifted focus from the rural sector to urban and global issues after the economic reforms process in 1991. In 2005, as the farm crisis grew in proportion, public interest litigations and governmental evaluations rose; the news was picked up by nation-wide media channels in 2006. The public meetings in which issues of the farm crisis were discussed were held at university or public spaces in Maharashtra and Delhi, highlighting the real economic and ecological problems of farmers, minus the glitz and "technical" sophistication of the GM conferences.

Strangely absent from these debates were agricultural scientists, both those who were practicing biotechnology and those who had participated in the Green Revolution. On a field trip to Karnal, Haryana, to examine the rice and wheat consortium project being undertaken in the Indo-Gangetic Plain with scientists from the International Center for Maize and Wheat Improvement (CIMMYT), I learned that most scientists thought that the farm crisis was a result of wasteful expenditure by farmers. What might be the role of economic policy or technology in causing this farm crisis were not issues the scientists intended to ponder.

Limitations in Getting Data: While looking for cropping pattern data, I encountered the mammoth bureaucratic machinery of state governance; however, I was not fortunate enough to get any data on agricultural production in Vidharbha from the Agricultural Department in Nagpur, which shows the apathy of the government

[8] A spate of farmer suicides occurred in the Vidharbha, eastern Maharashtra in 2005. The use of the word farm crisis denotes this episode of farmers' suicides. The exact numbers of these suicides are detailed in Chapter 4.

departments towards the farm crisis. To create an understanding of state policies relating to agriculture, I had hoped to find parliamentary debates and annual reports in libraries in Delhi, specifically the Parliament Library. Nevertheless, the documents at Parliament Library were not as easily accessible as I had assumed they would be. In addition, reading the reports that were available did not give me the kind of information needed to build a historical and policy analysis of the Green Revolution and post Green Revolution period. Comparing my experiences in Vidharbha with the GM policy discourses in Delhi, and with the Green Revolution and sociology of technology literature, I understood the limitations of the technology-centric framework as well as the environmentalist framework in understanding and acting upon the problems of cotton farmers.

Roadmap of the Dissertation

Chapter 1 introduces the research problem, questions, significance and experience. Chapter 2 discusses the claims and counterclaims regarding the benefits and risks of GM crops, reviews the literature on sociology of technology studies and presents the research design. Chapter 3 revisits the Green Revolution and identifies a conceptual framework for assessing the benefits and risks of GM technology. Chapter 4 examines the current ecological and economic context of cotton farming in Vidharbha. Chapter 5 illustrates the changed national policy and institutional environment vis-*à*-vis agriculture post-economic reforms in which Bt cotton has been introduced. Chapter 6 examines the relationship between the textile industry and cotton sector, and the new challenges that removal of the MultiFiber Agreement (MFA) poses to the livelihood of cotton growers in Vidharbha. Chapter 7 concludes by discussing policy alternatives to farming Bt cotton.

Chapter 2

UNDERSTANDING THE BENEFITS AND RISKS OF GM CROPS

Genetically modified (GM) crops were first introduced in the United States in 1996. Since then there has been a considerable increase in areas in which GM crops are grown in both northern and southern countries. In 2007, GM crops covered 25% of the total area under cultivation of the world. The United States, Argentina, Brazil, Canada, and China accounted for 95% of all transgenic crops grown (Thies and Devare 2007). Bt cotton, the first of the GM crops, was adopted in India in 2002, amidst much fanfare and controversy.

In the past ten years, GM crops have received wide publicity in the popular press, academia and policy circles, both nationally and internationally. GM crops have been discussed in numerous large conferences funded by private and international donors and the Indian government, biotech fairs,[1] and GM testing workshops.[2] GM crops are being promoted via newsletters,[3] biotech magazines[4] and newly created biotech industry bodies. In six years, 58 Bt cotton varieties and GM eggplant have been released in India (ISAAA 2006), while cabbage, cauliflower, corn, groundnut, mustard, okra, pigeonpea, rice, and tomato are under development and in field trials.[5]

[1] For instance, a Confederation of Indian Industries Workshop titled "Technology in Agriculture: Growing Farmers' Wealth" held in December 2006 showcased the technological developments in food and agricultural sector.

[2] A National Workshop on Management of Field Trials of GM crops, for example, was held in Delhi in August 2005 that discussed the modules of standard operating procedures of field trial guidelines.

[3] Some of these newsletters are from organizations such as International Acquisition of Agribiotech Services, Agribiotech, and South Asia Biosafety Program.

[4] Two new magazines have been introduced recently in India that focus on biotechnology, namely, Biospectrum and Times Agricultural Journal.

[5] Background Note on National Consultation on Regulation of Genetically Modified Food. Prepared by Biotech Consortium India Limited and All India Crop Biotechnology Association, April, 2005.

In spite of six years of growth in farmers' fields, positions regarding the benefits and risks[6] of GM crops continue to be deeply polarized. GM proponents argue that GM crops will increase productivity and farmers' profits, reduce environmental damage, cure micro-nutrition deficiencies, and alleviate poverty. In contrast, the anti-GM discourse focuses on the effects that GM crop technology might have on farm and forest biodiversity and farmers' rights to save the seeds.

First, I document the claims and counterclaims[7] of the local and global GM debate through a review of journal articles, conference proceedings relating to GM crops held in Delhi between the years 2005 and 2007, and newspaper clippings. Second, I review the literature in the field of science and technology studies and elaborate on factors the GM debate fails to address in terms of the social and political aspects of the technologies, which provides an understanding on how to settle the question of the risks and benefits of GM crops. Lastly, I present the research design of the dissertation by elaborating on the literature in science and technology studies and examining the history of the Green Revolution.

Gene Revolution Discourse

The benefits of GM technologies are discussed around three themes: increasing productivity, alleviating poverty and protecting the environment. The opposition largely speaks of the potential environmental after-effects of GM technologies and to some extent the institutional inefficiencies of adopting GM crops that lead to low

[6] The use of the term "risks and benefits" is special here. This term has been used often in literature regarding GM crops. For instance, see Pinstrup Anderson and Schioler (2002). *Seeds of Contention*, Cornell University Press. Other papers that use the term risks and benefits with regards to GM crops include: Bhagavan and Virgin (2006). *Agricultural Biotechnology in Developing Countries: A Briefing Paper-SIDA*. Stockholm Environmental Institute. Accessed at: http://www.sei.se/risk/Agricultural_Biotechlowres.pdf

[7] Term suggested by Professor Stephen Hilgartner, Ph.D. Committee Meeting, Ithaca, Cornell, July, 2006.

benefits for the farmers. The section below illustrates the major arguments that are being made vis-à-vis benefits and risks of GM crops, Bt cotton and agricultural bio-technology.

Benefits of GM Crops[8]: For its global proponents, GM crops are a multi-benefit package for farmers in developing countries. GM proponents display a great faith in universal technological solutions and the role that technology can play in increasing agricultural productivity. For instance, Lipton (2007) suggests that impressive inventions such as new techniques of plant dwarfing can produce a watershed of applied innovation and adoption. The flow of technological innovation and adoption inevitably peaks and then declines, unless the source is replenished through new inventions. Despite important advances in conventional plant breeding, Lipton (2007, 42) argues that "transgenics seem to be the only new way to restart the Green Revolution process of poverty reduction." He further explains that modern seed research has generated improved varieties that raise the conversion efficiency of land, water, sunshine, plant nutrients and pest management in crops. Similarly, through biotechnology, "productivity gains could have the same poverty reducing impact as those of the Green Revolution" (Pinstrup-Anderson and Cohen 2000, 22). Thus, production efficiency so raised through technological interventions will automatically be converted into productivity and poverty reduction and will be universally available.

According to Lipton (2007), GM crops are a potential antidote to nutritional poverty that affects the poor and children the most. Golden Rice, a transgenic crop developed by Syngenta, promises to help children and unskilled laborers in developing countries by addressing Vitamin A deficiencies. Syngenta claims that better nutrition

[8] While these arguments are being made vis-*à*-vis all GM crops, they can be applied to Bt cotton as well. Bt cotton is a form of GM crop. This dissertation speaks to the larger question of benefits from GM crops and not only Bt cotton.

can help boost the productivity of workers and have a positive impact on poor people's welfare (Anderson and Jackson: 2004). Similarly, Borlaug (2000) suggests that agri-biotechnologies (GM crops) hold the potential to feed the world; and the prospect of world security depends on their adoption (Borlaug 2000).

Besides increasing productivity and alleviating poverty, as GM proponents see it, GM technologies can protect the environment. According to M. S. Swaminathan (2006), GM crops are superior to the conventional Green Revolution crops that used pesticides and led to environmental damage. Swaminathan (2006) coined the term "Evergreen Revolution" to include ecological sustainability as an important function of GM crops. Given their properties of reducing pesticide consumption, GM technology is reported to play a beneficial role in saving biodiversity and protecting the environment (Lipton 2007).

GM crops are so essential that for its sake, risks must be undertaken. For instance, Pinstrup-Anderson and Schioler (2001) suggest,

> Most of our actions involve an element of risk and not many things come with a lifetime guarantee — the only way a family can guarantee that no harm will come to their heirloom crystal is never to use it. Most forms of progress carry some risks. Of course, we weigh the risks and benefits and do everything we can to reduce risks. This is the understanding on which genetic modification is carried out, whether designed to solve agricultural, medical or technical problems. Refusing to embark on anything new, until an official guarantee can be given that all risks have been eliminated, as some parties would have it for GM plants, is tantamount to bringing progress to a grinding halt. (Pinstrup-Anderson and Schioler: 2001, 26)

Pinstrup-Anderson and Cohen (2000) argue that if the potential of GM crops is not harnessed by developing countries, then opportunities for reducing poverty and food insecurity will be missed and the productivity gap between developing and developed countries will widen. Further, Anderson and Jackson (2004) warn developing countries of the consequences of not adopting of GM crops, suggesting

that if one developing country has adopted GM crops, those who have not will face higher costs of non-adoption.

Any kind of risks that GM crops might pose could be managed, through appropriate biosafety risk assessment systems (Cohen and Paarlberg 2004). Thus, the challenge for the developing countries is how to manage the risks rather than whether to deploy the technology, particularly because biotechnological benefits will be mostly domestic for their own producers and consumers (Lele 2003). The mechanism through which technology is transformed into better productivity, better nutrition, better incomes or environmental protection in different social and political contexts is not elaborated on in such arguments.

Yet others (Herring 2007, Fukuda-Parr 2007, Nuffield Council 2003), a bit cautious, accept that GM technology is risky and suggest that there is a developmentalist consensus concluding that the world's poor may benefit from genetic engineering, although under certain "conditions." While Herring (2007), Fukuda-Parr (2007), and Nuffield Council (2003) allude to the importance of understanding the effects of GM crops under different agrarian systems, crop systems, scientific advantage of the country in producing GM crops, and agro-ecological conditions or trade policies of a nation, they do not present detailed empirical studies to identify the "conditions" under which GM technology will provide benefits to the poor in a specific place or country.

Not only a global discourse but also a national one is being carried out regarding the benefits of GM crops in terms of increased productivity. For instance, Pratibha Patil (2008), current President of India, in her keynote speech to Sher Shah University of Kashmir, recently called for a "second Green Revolution." She suggested that there is a need for enhancing agricultural productivity with the help of new agricultural bio-technology (GM crops) and fertilizers (Deccan Herald, 27 May

2008). A similar call for increasing productivity through technology was made by the Prime Minister, Manmohan Singh, at the inaugural session of the 93rd Indian Science Congress:

> Three challenges that science and technology must address to promote rural development are in the areas of increasing agricultural productivity covering land, labour, seed and plant, development of affordable and appropriate technologies for energy and water and its increased usage in both farm and non-farm business. (The Hindu BusinessLine, 4 Jan 2006)

Major national agricultural research systems (NARS) established during the Green Revolution, as well as the Ministries of Science, Ministries of Agriculture, and other biotech entrepreneurs espouse the benefits of biotechnology for Indian agriculture, especially in increasing productivity.

Besides productivity, agri-biotechnology is suggested to have other benefits such as poverty alleviation and better nutrition. Thus, according to the Minister of Biotechnology, M.K. Bhan, "Agri-biotechnology is a tool to improve crop productivity, reduce losses due to biotic and non-biotic stresses, and make efficient use of inputs."[9] Similar statements are made by the heads of national and international agricultural institutions. According to William Dar, International Center for Research in Semi-Arid Crop Technologies (ICRISAT), "Developing appropriate technology holds the key to increase crop productivity, food security and poverty alleviation."[10]

The importance of GM technologies was also asserted at the 12th B.P. Pal[11] memorial lecture held at the Indian Council of Agricultural Research (ICAR), by

[9] M.K. Bhan was speaking in a prominent international conference titled "Agricultural for Food, Nutritional Security and Rural Growth" held by Tata Energy Research Institute, a leading national non-governmental organization in Delhi, on September, 2006.

[10] Speech, William Dar, ICRISAT,"Modern Biotechnology for Sustainable Crop Productivity" at the 2006 Tata Energy Research Institute Conference on "Agricultural for Food, Nutritional Security and Rural Growth" held at Tata Energy Research Institute, Delhi.

[11] B.P. Pal was a noted plant geneticist who was a key figure in ushering in the Green Revolution.

Mangala Rai, the Director General of ICAR. In a lecture titled "Harnessing Genetic Power to Enhance Agricultural Productivity, Profitability and Resource Use Efficiency," Rai suggested that "Genes are essential to revitalize Indian agriculture." According to Kiran Mazumdar (2006), a biotech entrepreuner, "Biotech crops are needed by Indian agriculture to be comparable in agri-productivity with the world, where GM corn and other GM crops are being grown."

Bt cotton, the first GM crop in India, is representative of the nature of gains that farmers can make through the current and future adoption of GM crops. Through empirical studies in parts of India, GM proponents argue that Bt cotton has reduced pesticide use, controlled the Bollworm pest and reduced cultivation costs, for instance, in Maharashtra (Qaim and Zilberman 2003). Gains are expected to increase as more and more users adopt Bt cotton. Bt cotton has not only raised yields but also allowed farmers to get better prices for their produce (Bennett, Ismael, and Morse 2006).

Given their immense benefits, according to the GM proponents, GM seeds are popular among farmers. The rapid increase in area under Bt cotton in India (James 2006) and globally, is a sign of consumer satisfaction and of farmers' faith in technology (Outlook of Agriculture 2005). The spread of illegal seeds has become a dynamic cottage industry driven by farmers who have seized the gains of the new seeds. According to proponents, they are "experimenting" with transgenic seeds, without caring about notions of globalization or the power of monopolist seed agencies as anti-GM activists suggest.[12] This shows that "farmers have voted with not only their feet, but also their ploughs down for Bt technology" (Herring 2007). Such arguments conflate adoption of Bt cotton with the success of the technology.

[12] This stands in contrast to the model of diffusion proposed by the environmentalists such as Vandana Shiva (2006) where farmers are portrayed as helpless victims of seed agencies such as Monsanto.

In such arguments, technology does everything, and social, political, institutional and political conditions matter but only secondarily. As studies in the disciplines of science and technology reveal, these conditions matter to who benefits and who loses from new technologies and the process of how these benefits are created. The section on research design or more elaborately, Chapter 3, "Revisiting the Green Revolution" provides a more sociological understanding of the Green Revolution and highlights the process of how farmers made gains from the Green Revolution technology, what kind of farmers they were and the role that state institutions played in creating these gains.

Risks of GM Crops: GM crops have drawn, and continue to draw, criticism at both global and local levels, particularly because of the risk they pose to biodiversity on forests and farms, to farmers' rights and to human health. Sanvido, Romies and Bigler (2007) suggest that because GM crops are manufactured through genetic manipulation, a risk is present that genes in GM crops could unintentionally flow from transgenic gene species to wild species, which could lead to the extinction of the sexually compatible wild species. The use of GM crops could also lead to contamination of the non-GM crops, and that would lead to problems for those farming organic crops, for their organic certification could be revoked (Thies and Devare 2007). The researchers also hypothesize that gene products persist in the environment itself with deleterious effects because GM technologies have been proved to harm unintended and beneficiary organisms. Other deleterious effects have been noted too. For instance, Losey, Rayor and Carter's (1999) study of the effects of Bt corn found that the larvae of the monarch butterfly, *Danaus plexippus*, reared on milkweed leaves dusted with pollen from Bt corn, ate less, grew more slowly and suffered higher mortality than larvae reared on leaves dusted with untransformed corn pollen or on leaves without pollen. GM crops are also hypothesized to make crops

weedier, and create resistance in the pests that they are intended to target. GM crops could also have other negative effects on the larger environment. According to Singh et.al (2006), although it has not been scientifically proven, genetically mutated toxins used in GM crops could hypothetically lead to soil contamination, threatening the very resource on which agriculture and forests depend. These arguments, especially regarding the hypothesized risks of GM crops on the environment, even if they are correct, are difficult to prove.

Vandana Shiva, an advocate of organic food, has been attacked by political scientists for her views on GM crops. For instance, Herring (2006, 2007) criticizes her for not practicing science as real scientists do in laboratories.[13] Furthermore, the environmental frame is too narrow to understand the wide range of economic risks and benefits or problems of GM crops. Anti-GM activists also claim that the GM crops that require the presence of a harmonized set of intellectual property rights (IPRs) are incompatible with farmers' rights: "IPRs are an important part of agri-business controlled agriculture in which farmers no longer grow native seeds but grow seeds supplied by the transnational corporation industry. IPRs become a monopoly that wipes out farmer's rights to save and exchange the seeds" (Shiva: 2005).

GM crops allow seed monopolies to gather profits even though it is the farmers whose practice has preserved plant and seed biodiversity for centuries. The gathering of profits by seed monopolies is facilitated by international trade and finance institutions such as the World Trade Organization (WTO). "The state is under siege," writes Vandana Shiva (2005). "New IPRs are being introduced in the area of plant genetic resources under the pressure of the U.S. government in the Trade Related Intellectual Property Rights (TRIPs) regime, under the WTO." By allowing the IPRs

[13] Interview, Harish Damodaran, Associate Editor, HinduBusinessLine, July, 2007.

that favor corporate monopolies over farmers' benefits, these international institutions are facilitating a corporate takeover of Third World agriculture.

While anti-GM activists, as mentioned above, appropriately bring in the role of institutions as they affect farmers' profits, they do not discuss them in a comprehensive and nuanced manner on revealing the detailed mechanisms through which such policies and institutions affect the farm economy and farm incomes. For instance, what are the specific WTO or global economic and trade measures that affect the domestic prices of agro-commodities such as cotton?

Examining the experience of farmers with Bt cotton, Sahai and Rehman (2004) suggest that neither has Bt cotton reduced pesticide consumption nor has it decreased costs of cultivation, for it requires a higher amount of yield enhancing inputs. Given that the fields are swamped with illegal variants, there is no evidence that it was the branded Bt cotton that raised yields in the farmers' fields as claimed by the seed companies.[14] As such, the arguments that are not addressed are the farmers' previous income, their production problems, how the technology helps them alleviate these problems, and how "certain" are the gains that GM technology promises in Vidharbha. A contextual understanding of the economic, political, ecological and institutional factors or "conditions" is amiss in the discourse of both supporters and opponents of GM crops.

Social and Political in the Technical

Many of those promoting GM crops focus on the effects that technology would have on society in terms of preventing environmental degradation, increasing food supply, or reducing poverty. Technology is seen as standing apart from society, yet

[14] While the illegal Bt cotton is also a Bt variety, the germplasm of the variety is Indian. The larger conflict is about the Bt technology and its effectiveness.

able to change it. As Smith and Marx (1994) put it, technology takes a life of its own: not only does technology define what society can do, but it is also independent of social or political influences. Technology is transformed into productivity through some inherent agency in technology and productivity into income gains. Consequently, GM technology produces similar beneficial results under different country conditions, in different societies and in different land-tenure or political governance systems. Thus, for GM proponents, technology is equally accessible by all sections of society, whether resource poor farmers who have no access to irrigation and have poor links with markets or well-connected ones who possess greater political and material clout. Farmers in drought-prone and marginalized regions who already face uncertain productivities can access these technologies on equal terms and get "certain"[15] benefits from new ones as do farmers in resource rich areas. Although both political and material resources matter, what also matters is the entrepreneurial nature of farmers that is driven by their psychological condition.[16]

In a similar framework, the anti-GM discourse focuses on the importance of environmental factors and pays little attention to societal or political factors except insofar as these factors refer to the importance of technology ownership by multinationals, farmers' continuing reliance on pesticides, poor profits and effects of globalization on the rural poor. Missing in the debate is a nuanced account of how social and political factors interact with technology or how political, economic, social and ecological contexts matter in determining the effects of technology on society. While Nuffield Council (2003), Herring (2007), Fukuda-Parr (2007) and Bhagwan and Virgin (2006) have underscored the importance of considering the "conditions" under

[15] Guaranteed.

[16] Interview, Pearl Drego and Vatsala Shivsubramanium, Psychotherapists, July 2006 and July, 2007, Delhi, India

which farmers can benefit from GM crops, such as agrarian systems, crops, agro-ecological conditions or trade policies of a nation, they have not gone ahead very much in showing these links or producing empirical studies to demonstrate the same.

Studies in the field of technology and society indicate that technology is not a black-box hardware with external effects. Technology does not contain the independent agency for initiating and continuing change. Or as Smith and Marx (1987, xii) state, it is questionable whether technology is an "abstract, disembodied, quasi-metaphysical agency, as an initiator of actions capable of controlling human destiny."

Agency is also part of the larger society and political institutions in terms of both shaping technology and the effects that technology has on society. Societal or political factors influence the design and functioning of technology as much as technology affects societal relations. The interaction between technology and society is a two-way process. As Wynne (1987, 22) notes, "The formal public image of technology as mechanical rule-following behavior belies the far less clearly rule-bound and determined world of technological practices."

Social Shaping of Technology: Social shaping of technology can happen in many ways. For instance, Pinch and Bijker (1987) highlight the role of social actors and processes in driving technical change. They note the role of socially relevant groups in ascribing different meanings or problems that can be solved through the creation of a particular technological artifact. They also highlight the process of social negotiation of conflicting meanings during the development of the artifact, for each technological artifact has "interpretive flexibility." When the relevant social groups consider the problem to be solved or the controversies regarding the technology fade away, closure or stabilization of the artifact is reached (Pinch and Bijker 1987).

Moving away from a strong socially constructivist program, agency is also ascribed to the technology itself. Hughes (1987) presents the network approach, which

sees technological systems such as electric or power systems, composed of interconnected components, as diverse such as physical artifacts, mines, firms, utility companies, laboratories and bank networks. These components interact with one another and contribute to a common system goal to make the system function. Builders of technological systems — inventors, engineers, managers and financiers — who create technological systems are also components of the technological system though not artifacts. Therefore, a technological system has distinct social components. Similarly, the actor-network theories developed by Latour, Callon and Law (see Hassard and Law 1999) see social and technical actors as enrolled into a network by means of negotiations. Actors translate the world according to their intentions and ascribe to the artifact a particular identity and way of functioning. However, this interaction between the human and non-human actors is not a one-way process.

Humans and non-humans exchange properties while interacting, as the technological artifact translates human goals into action. For instance, in outlining the agency of a speed bump, Latour (2005) observes that it is capable of translating human goals such as slowing down and is capable of translating the intentions of the urban planners, architects, engineers and so on. Thus, technological artifacts act as controllers of speed and humans and non-humans exchange properties, so a speed bump cannot be considered to be something inert and incapable of action. Agency is contained in the non-human technology while technology and social factors shape each other.

Technology has political effects, through its design, which can lead to excluding certain users over others. As Winner (1986) argues, technological artifacts embody politics through invention, design and arrangement. They establish patterns of power and authority, thus excluding some from its use over others. For instance, the bridges on Long Island, New York were designed in a manner that they provided only

limited access to minorities traveling to Jones Beach. Such a design embodied a particular vision of social order. Similarly, Ackrich (1987) underscores the concept of "inscription," wherein designers of artifacts inscribe certain visions of the world in the technical content of the new object, and define actors with specific tastes, competences, motives and aspirations who will use the technology. Like a film script, technical objects define a framework of action together with actors and the spaces in which they are supposed to act. During the process of "description," users might or might not follow the roles inscribed in the technological artifacts by designers. Here certain users might be excluded through the form and design of the technology or be unable to access the full benefits of the technology.

Some of the effects of technology might not be what the designer intended and could lead to harmful consequences, given the social set-up in which the technology is being introduced. For instance, as Bose, Bereano and Malloy (1984) show, household appliances are not labor saving devices as they are expected to be, for they lead to increased work time. These appliances require costly and time consuming repairs and replacement so that the cleaning of kitchen appliances becomes a major project in itself. Also, household appliances have given rise to new forms of housework. Many household appliances or technologies might reflect the designer's bias and have negative consequences. Feminist critiques of technology show that often household technologies were made to satisfy the needs of male designers, rather than female house-workers (Berg and Lie 1995).

Similarly, Cowan (1976) shows how the invention of household technologies led to the disappearance of maids, cooks and cleaners so that all the household chores had to be performed by housewives. Doing such household chores for the family was tied to the image of being a good housewife through careful advertising by the manufacturers of these technologies. The advent of such technologies transformed the

middle class, fairly well-educated housewife into a chauffeur, charwoman and short-order cook. “The industrial revolution heightened the emotional context of work, until a woman’s self worth became a function of her success at arranging bits of fruit to form a clown’s face in a gelatin salad” (Cowan 1976).

Inequality and hierarchy already exist in society. Technology, once introduced in such a society, might allow some to win and some to lose power and might privilege one over the other, leading to a change in social relations (Pearse 1983). Technology could also shape societal relations given the attendant inputs that it requires in order to function. For instance, Winner (1980) contends that a nuclear power plant requires the existence of techno-military-scientific elite to manage it. On the other hand, solar energy is more compatible with a democratic and egalitarian society than is required by a coal or petroleum plant that requires centralized and large-scale political systems to work effectively.

Thus, the same technology may have different effects in different societies. User agency has been recognized by science and technology studies scholars. As Woolgar (1991) contends, the likely impact of new technology is built in during the process of evolution and design, but deconstructed and reconstructed during usage. For instance, farm families in rural areas used the car, not only for transportation but also to power washing machines, corn shellers, balers and corn grinders. Such uses of the automobile led to the development of other rural equipment like tractors. While science and technology studies literature makes us aware of the ill effects of technology, this is not to say that technology does not lead to good effects depending on the nature of technology and the conditions under which it is adopted. Not adopting technology could be another option, but one has to consider carefully qualitative indicators, while adopting the new technology to determine its impacts on society.

Research Design

From the literature review on the GM debate, four sets of assumptions are clear. A first set of analyses focuses on select regions in India such as the central-western state of Gujarat. Using qualitative interviews, the authors suggest that Bt cotton has been adopted widely and is successful (Geisler, Roy and Herring 2007). However, the Bt cotton variety that is being grown in Gujarat has a very different germplasm than is being used in other cotton growing regions with a much lower cost of production than branded or other varieties of Bt cotton. The latter are adopted in other parts of India under different ecological and economic circumstances, in irrigated versus rainfed areas or for richer versus marginal farmers. A second set of analyses discusses the risks and benefits of GM crops at a global level (Pinstrup-Anderson: 2002) or predicts the success of GM crops on the basis of Green Revolution successes in alleviating poverty (Lipton 2007). These analyses do not consider social or political contexts in which the new technology is being adopted to understand the nature of impacts that the new technology will have on society. A third set of analyses looks at the hypothetical environment risks of GM technology (Sanvido, Romies and Bigler 2007). However, these are hard for social scientists to prove. A fourth set of analyses does focus on the role of trade and institutions and country policies, e.g., Shiva (2006) and Sahai (2006), but none goes far enough to pay any rigorous attention to the multiple level of "contextual" or "conditional" factors that might influence the benefits that cotton farmers get from planting Bt cotton.

Literature from science and technology studies and the Green Revolution, an important technology of the 1960s, makes us aware that the effects of technology are conditioned by social and political factors (see section on Social and Political in the Technical in Chapter 2 and Chapter 3 for an elaborate discussion of these literatures). The reason I choose the Green Revolution as a useful comparision with the adoption

of GM crops is that over the past decade, the new line of GM crops that has been developed has been likened to be a logical successor to the 1960s Green Revolution technologies. Many important players in the Green Revolution have referred to the adoption of transgenic technology as the "Second Green Revolution," 'the Doubly Green Revolution" (Seralgeldin 2002) and "the Evergreen Revolution" (Swaminathan 2006) (see Section on Gene Revolution as Green Revolution in Chapter 3 for a greater elaboration of this point).

Even while scholars have likened the Green Revolution to the Gene Revolution, there are differences between the two. These differences impact the nature of gains that farmers can make by adopting new technology. Thus, while a comparision can be made between the Green Revolution and Gene Revolution, there is a need to understand the context in which the new technology is embedded. Important agrarian scholars such as Herring (2007) have pointed towards the importance of contextual factors and underscored the importance of empirical research on "specific agrarian systems or crops to understand the nature of gains from GM crops." Fukuda-Parr (2006) speaks of the importance of studying the "conditions" in specific countries under which GM crops have been introduced to understand their benefits. Not many systematic studies are available in this regard. In order to examine the context of GM technology, I use Green Revolution literature to identify the micro and macro societal, political and institutional factors in understanding effects of technology on farmers' incomes. The Green Revolution literature highlights the importance of three conditions under which farmers make gains from new technology (see Chapter 3 for an elaborate discussion of this literature):

- Initial economic and ecological conditions of farmers
- Presence of supportive policy and institutional environment
- Bargaining power of new farmer movements

Based on these findings, I evaluate the gains that cotton farmers make in Vidharbha from the new GM technology through three sub-questions:

- What are the economic and ecological conditions of cotton farmers in Vidharbha?
- Under what local, national and international policy and institutional arrangements do cotton farmers in Vidharbha adopt Bt cotton?
- What kind of bargaining power do cotton farmers possess in the current, new economic regime?

The experience of the Green Revolution makes it amply clear that initially only those farmers who were better connected to both economic and ecological resources could benefit from the technology. Thus, it is important to understand the initial economic and ecological conditions of cotton farmers to ascertain whether they can make gains from the new technology. The experience of the Green Revolution further shows that there were specific policy and institutional preconditions that led to the successful adoption of the new technology by farmers and for the gains they made. So, it is important to investigate the nature of the policy and institutional conditions under which Bt cotton and GM crops are introduced and whether these are conducive to benefits for small and marginal farmers. The experience of the Green Revolution also shows the power of farmer movements for farmers to obtain and continue to obtain a good price for rice and wheat and to maintain power, fertilizer and irrigation subsidies. Therefore, it is imperative to obtain information regarding the nature of political power that farmer movements possess, in particular, the cotton farmer's movement in the current Indian political scenario.

I have focused my study on a particularly distressed agrarian environment, that of Vidharbha, eastern Maharashtra. To understand the social, political and institutional context of the introduction of new GM seeds, especially so in distressed environments,

I have relied on a qualitative[17] case study approach.[18] Stakes (2005) identifies three types of case studies — intrinsic, instrumental and multiple. The intrinsic case study approach is undertaken because the case in all its particularity and ordinariness is itself of interest. An instrumental study is one where a particular case is examined mainly to provide insight into an issue as well as to draw a generalization. The case is of secondary interest; it plays a supportive role and it facilitates our understanding of something else. The case may be typical of other cases or not. A multiple case study undertakes a number of cases to investigate a phenomenon, population or general condition. I have used the case of Vidharbha as both an intrinsic and instrumental case study to reflect on the state of affairs in rural rainfed India and the nature of gains that can be made in adopting Bt cotton in such areas. Vidharbha is an appropriate site for study, for it was the epicenter of the farm crisis (Planning Commission 2006).

Farming in Vidharbha, Maharashtra is characteristic of dryland rainfed areas in India. Rainfed farming in India, especially in dryland areas, is distinguished by high risk factors such as a poor resource base (soil condition, water availability), low investment capability, weak infrastructure and instability of production (Ministry of Agriculture 1996). Farm suicides starting in 2005 in Vidharbha have not abated. In

[17] According to Ritchie and Lewis (2003), qualitative methods address the problem of fixing meaning where they are renegotiable and variable in relation to the context of use. Using such methods can help avoid the problem of overwriting internally structured subjectivities with apriori structures of meaning (such as that with standard instrument surveys) (Henwood 1996). According to Denzin and Nelkin (2005), "Qualitative Research is a situated activity that locates the observer in the world. It consists of a set of interpretive and material practices.These practices transform the world. They turn them into a series of representations, including field notes, interviews, conversations, photographs, recordings and memos to themselves. Qualitative researchers study things in their natural settings, attempting to make sense of, and interpret, phenomenon [sic], in terms of the meanings that people bring to them." Qualitative methods are based on the collection of a variety of empirical materials- case study, personal experience, interviews, cultural facts, cultural texts and productions, observational, historical, interactional and visual methods that describe routine and problematic moments and meanings in individuals' lives. Tools such as interviews, focus group discussions, documents research, archival research, all form a part of the repertoire of these approaches.

[18] Yin (2003) states that a case study is a preferred strategy when "how" and "why" questions are being posed, when the investigator has little control over the events and when the focus is on a contemporary phenomenon within some real life context.

fact, most of these suicides are located in low rainfall, low irrigation tracts of India such as Andhra Pradesh, Maharashtra and Karnataka (Vaidyanathan 2006). The reasons for farm suicides are manifold:

> People are driven to the extreme step of suicide not only because of imprudently large borrowing from high cost sources and for non-productive uses but also because the increase in net incomes from loans used for productive purposes falls far below expectations. Suicide-afflicted households have also borrowed heavily for digging/deepening wells and for cultivating input-intensive high-value crops in the expectation of high yields and good prices. Failure of these expectations is a major reason for their inability to repay these debts. (Vaidyanathan 2006, 4009)

Gujarat vs. Maharashtra: The introduction of Bt cotton in Gujarat, a place where no farmers have committed suicides, has been cited frequently in GM cotton literature as a case for successful adoption of Bt cotton (see Herring 2005; Roy 2007). It would have been a good question to ask why Bt cotton succeeded in just that one place and not another (Maharashtra). However, Gujarat is an outlier case in understanding the impacts of Bt cotton because the Bt cotton here is grown from an informal germplasm variety that was produced by a local seed company, Navbharat 151. The Bt technology used with this germplasm was reportedly stolen from Monsanto. Consequently, this variety is available at a much lower cost than the branded Maharashtra-Mahyco (MMB) variety, leading to a lower cost of production in Gujarat (Down To Earth 2006). The cost of illegal Bt seeds in Gujarat is USD 13.33 vis-à-vis the cost of Bt seeds in Maharashtra, i.e. USD 40.[19] There might be other factors at work, which are giving a much lower cost of production in Gujarat than Maharashtra such as a more developed extension system,[20] better irrigation networks[21]

[19] I USD= 45 Rs. Cost of Illegal Seeds is Rs 600 (Rs.600/45=13.33 USD). Cost of Branded Seeds is Rs. 1800 (Rs1,800/45=40 USD). According to Table 5.1 the seed costs are 6.04% of the total cost of production when seed cost is Rs 1,600 or 35.56 USD.

[20] Interview, Mahesh Rangarajan, Department of History, Delhi University, Delhi, May, 2009.

[21] Interview, Ashok, JK Seeds, Nagpur, Maharashtra, August, 2006.

and better marketing through cooperatives (Gujarat has a tradition of such a well developed cooperative system), but this will need a more detailed investigation.

Further, given the statistics that began to emerge regarding a distressed situation at the level of the Indian agricultural sector, conducting a comparative case study within the agrarian sector becomes redundant.[22] The National Commission of Farmers (NCF) was constituted in 2005 to examine the problems of distress in the agricultural sector. M. S. Swaminathan, a prominent figure in agricultural and social development and R. B. Singh, Additional Director General, Food and Agriculture Organization (FAO) were appointed by the Indian government under Sompal, the Agricultural Minister, to examine this agrarian distress. Commenting on the situation of the agricultural sector at large, Dr. R. B. Singh, of the NCF, suggested that "no government can afford to ignore agriculture."[23] Furthermore, Mukul Sanwal, of the United Nations Framework of Climate Change Convention, said that "Even while there is an agrarian crisis, these issues will be taken care of through electoral politics."[24] Clearly, problems were brewing at the level of the agrarian sector in India. Table 2.1 presents the contributions of economic sectors to GDP and changes between 1970 and 2007. As Table 2.1 shows, the share of the GDP in agriculture is declining (even after the introduction of GM crops), as it changes from 42% to 22% between 1970 and 2007. In comparision, the share of the GDP in the service sector has increased considerably (35-52%).

[22] Political scientist Ron Herring makes this point in his course syllabus in comparative political economy that instead of class as actors, one needs to also look at sectors as actors. Agrarian Economist Pranab Bardhan makes this point in his book *Political Economy of India's Development* that one needs to conceptualize India's political economy in terms of classes.

[23] Interview, R. B. Singh, Previous Additional Director General, FAO, July 2006.

[24] Interview, Mukul Sanwal, Previous Joint Secretary, Ministry of Environment and Forest, now at the United Nations Framework Convention of Climate Change, April, 2005.

Table 2.1: Contribution of Sectors to GDP (Percent)

Sector/Years	1970	1980	1990	2007
Agriculture	42.00	35.00	29.00	22.00
Industry	23.00	26.00	27.00	26.00
Service	35.00	39.00	44.00	52.00
Total	100.00	100.00	100.00	100.00

Source: Gokarn and Gulati (2006). Data taken from Central Statistical Organisation

Certain development models predict that the share of agriculture in the overall economic GDP will decline as industry and services sector grow. The problem is not lack of growth in the sector, but the fact that the agricultural sector continues to be a major employment provider despite lack of growth. According to the Economic Survey of India (2007-2008), even while the share of agriculture in the GDP has registered a steady decline this sector continues to provide employment to 52% of the workforce in 2007-2008.

Rural-Urban Divide: Furthermore, the essence of this divide, between different economic sectors or urban (services and industry) and rural India (agricultural sector) was also captured in a speech made by the Prime Minister, Manmohan Singh, in 2005,

> The major challenge of our economic reform programme is that of balancing the growth process and bridging the various divides. One of the most significant divides in India has been between the urban and rural Indias. As I look at the history of India in the last 50 years, this gap has widened. It has not become narrower and there lies the great danger for social, economic and political instability.[25]

Reminiscent of the debate about rural violence in the wake of the increasing agrarian disparities during the initial phases of the Green Revolution in the 1960s (see Desai 1983), former Finance Minister Yashwant Sinha remarked,

> The impoverished rural poor do not need to walk twenty miles any longer to see how rich people live in cities. They are able to do this on television, which

[25] Speech, Prime Minister Manmohan Singh, Conference of Indian Industries (CII) Conference on Bharat Nirman. December 16, 2005. Accessed at: http://pmindia.nic.in/speech/ content.asp?id=248

> magnifies the disparities even further by the use of glamorous advertisement. Frustrated people without jobs or prospects are likely to turn to violence. (Cited in Frankel 2005, 2009)

Thus, identifying double (or triple) comparative case studies, such as comparing Gujarat and Maharashtra (Vidharbha), within the agricultural sector to understand the gains from new technology does not appear to be a useful research strategy. Instead, choosing Vidharbha as a representative case study for the problems and distressed condition in agricultural sector at large (especially so in rainfed areas) appears an appropriate research strategy. In Pierre Bordieau's recently published discussion with his student Loic Wacquant, he noted that "there was no need for Galileo to constantly repeat the slope experiment to construct the falling body model. A well-constructed singular case is no longer singular" (Hamel with Dufour and Fortin 1993).

Case studies rely on research methods such as documentation, archival methods, interview methods, participant-observation, and physical observation (Yin 1989). I have used the following qualitative methods to answer the above-mentioned subquestions.

- What is the economic and ecological condition of cotton farmers in Vidharbha?

To examine the ecological and economic condition of cotton farmers, I conducted interviews of select farmers in villages near Nagpur and Wardha cities; seed dealers in Nagpur; academics from Nagpur University; scientists at Central Institute of Cotton Research (CICR); grassroots non-governmental organizations (NGOs) dealing with agriculture and related social issues; local and state government officials of agriculture; and irrigation and planning departments in Vidharbha, Maharashtra. I used snowball sampling methods to identify my interviewees. Snowball sampling is a non-probabilistic sampling method, in which group members identify extended members to be included in a sample. As newly identified members

name other members, the sample grows like a snowball. Snowball sampling is used when a population listing is unavailable and cannot be compiled by the researcher (Henry 1990). I located some of the interviewees through news-reports already published on Vidharbha, some through the GM conferences I attended, and others through an online search of organizations already working in that area. I also used the Development Alternatives NGO Directory to locate the non-governmental organizations working in the area, although this was not very successful. The news reporters I spoke with when I first visited Nagpur, at *Indian Express*, *Lokmat* and *Agro-won* gave me further details on relevant stakeholders that I could interview to build the Vidharabha case study. Farmer leaders such as Vijai Jaywandhia, whom I had located through news reports, helped me connect with several farmers in the Nagpur and Wardha area. Then, I conducted open-ended and semi-structured interviews. In an open ended interview, the investigator can ask for the facts of a matter as well as for a respondent's opinions about events (Yin 1989). Semi-structured interviews are flexible, allowing new questions to be brought up during the interview as a result of what the interviewee says. The interviewer in a semi-structured interview generally has a framework of themes to be explored (Yin 1989). Some interviewees were met more than once, over a period of time (see list of interviewees in Appendix A). I made three trips of durations of 1–2 weeks to Vidharbha. I was located in Nagpur, a major town in Vidharbha, from where I took trips to several nearby villages. In addition to undertaking interviews, I also examined government reports, attended farmers and government meetings relating to the issue of farmer suicides and reviewed secondary documents such as NGO newsletters, newspapers, websites, etc. To get a better understanding of the condition of farmers in rainfed regions in India, I relied on governmental and non-governmental reports.

- What are the local, national and international policy and institutional conditions for adopting new technology?

To understand the process and conditions of technology adoption, I collected news articles, NGO and government reports and conducted open ended interviews with farmers, seed companies and academics in Vidharbha region and Delhi. To understand the linkages between the textile industry and cotton farmers, I reviewed secondary literature such as industry newsletters, journals, magazines and conference proceedings. I also studied two leading national newspapers, government reports, NGO documents and industry conferences literature to identify and understand macro-economic policies and their effects on farmers.

- What is the bargaining power of cotton farmer movements?

To understand the status of the cotton farmers' political power, I relied on books and journal papers on farmer movements in India, attending farmer and environmental NGO meetings in Delhi, and interviewing a number of farmer leaders and journalists.

From a Technocentric to a Sociological Understanding of GM Crop Impacts

The discourse on GM crops, both nationally and internationally, addresses the problems of farmers in a very techno-centric perspective. A literature review from science and technology studies, however, indicates that technology does have agency, but in consonance with other societal, political and institutional variables. Together, they determine the impacts that technology will have on society and human well-being. These impacts are well exemplified in the history of the Green Revolution, which shows that the Green Revolution varieties were introduced in the societal context which initially led the large farmers to benefit more than the small and marginal ones. The new technology was introduced in a safe and remunerative environment for increased production in which the state created conditions of

absorbing the risks that accompany the introduction of new technology. Also important to note in the political history of the Green Revolution, is the economic and ecological condition of farmers, the policy and institutional supports and the role of farmer movements in assessing the potential for deriving benefits from adoption of GM crops. Chapter 3 elucidates a detailed history of the Green Revolution.

Chapter 3

REVISITING THE GREEN REVOLUTION

The 1960s Green Revolution is popularly considered to be an important milestone in the history of South Asian agriculture. While the adoption conditions of GM crops during the Gene Revolution are different from the Green Revolution, many important players in the Green Revolution have referred to the adoption of GM crops as the second Green Revolution. In order to understand the effects of the Gene Revolution, the Green Revolution has to be revisited and the factors that led to farmers making gains have to be identified. The story of the Green Revolution is elaborated on below.

Making and Aversion of a Food Crisis

When introduced in India in 1965, the Green Revolution technology signified a key shift in India's agricultural policies from a previous focus on land reforms. Addressing the skewed land ownership patterns that had resulted from colonial rule[1] was a dominant theme of Indian agricultural problems in 1947. Besides land reforms, the agrarian policy called for increasing the area under cultivation, creating nation-wide extension services and improving traditional production techniques (Postgate 1975). Even though these reforms were introduced after partition, India was left with a shortage of food grains to feed its growing population. This shortage compelled India to import wheat from the United States as early as 1952 (Nehru 1997).[2] In 1965, food

[1] See Barrington Moore, *Social Origins of Dictatorship and Democracy. Lord and Peasant in the Making of the Modern Word.* Masachussets: Beacon Press, 1993 for an elaboration.

[2] Under the PL 480 scheme, overproduction of wheat was sold off to developing countries by the United States in local currency. PL 480 shipments allowed India to focus on its strategies of industrial development instituted under the Nehru regime and made food available to the urban and industrial population at cheap prices (Rudolph and Rudolph 1987).

scarcity became worse due to two years of continuous drought (Malhotra 1989). The problem was partly internal and partly external. The food zones that were constructed by the Indian state after 1947 for the movement of food grains between scarcity and surplus regions (or food zones) of the country did not function well.[3] Hoarding activities by traders did not allow enough food grains to come in the market. "I feel sad that this shortage of food supplies is also due to concerned sections not fully realizing their responsibility. Food grains are available, cereals are within the country and yet these are not coming into the market," noted then Prime Minister Lal Bahadur Shastri in 1964 (Shastri 1964a). As food grains got scarcer, food prices shot up and the resulting economic hardship led to mass discontent (Malhotra 1989).

A large-scale technology-led strategy for increasing agricultural production, known as the Green Revolution, was adopted in 1966. This policy signified a critical change from India's previous agricultural strategy of land reforms. The roots of the technological strategy can be found in the increasing involvement of the Ford Foundation in India's agricultural policies since 1957, through Grow More Food campaigns (Ross 1998). The involvement of the Ford Foundation in India's agriculture was not incidental, but was implicated in the larger international political economy of the Cold War. According to Ross (1998), the Ford Foundation was closely involved in taking forward U.S. foreign policy, amidst concerns about the spread of communism in Third World countries, particularly in India. A Ford Foundation Report (1959) titled "India's Food Crisis and Steps to Meet It," noted that this brewing "food crisis" was due to India's burgeoning population, and India needed

[3] Malhotra (1989) notes that India had a policy of dividing the country into food zones, each consisting of a surplus state and a couple of deficit ones. Food grain produced in demarcated food zones could move freely between the food zones, so that the surplus states could take care of the deficit ones, but internal movement of food between zones was strictly prohibited. Chief ministers of various states had later become hostile to food zones. During Prime Minister Shastri's regime, they pressed for their abolition.

to increase its food production on a "war footing."[4] Prepared by an American team of agricultural specialists, the report suggested the need for:

- Stabilizing farm prices by announcing a guaranteed minimum price and markets within distance
- Establishing a public works program for increasing food production and village employment
- Using chemical fertilizers along with irrigation, bunding, and improved seeds and other facilities
- Intensifying irrigation and drainage programs
- Selecting certain crops and certain areas for more intensive efforts
- Securitizing land reforms, land tenure and land consolidation
- Obtaining immediate large scale credit through cooperatives
- Reducing cattle numbers progressively. (1–11)

India, which had already been reliant on foreign aid for its five-year developmental plans, came under further pressure from external donors in 1964. The World Bank and the United States made the continued flow of foreign aid and PL 480 contingent on India's adoption of agricultural modernization policies and an increased role of foreign and domestic capital in agriculture (Corbridge and Harris 2000, Frankel 1978).

Further, a section of Indian policymakers were becoming convinced because of the Foundation's influence, and independently, of the need to increase food production through use of improved seeds and scientific practices. In 1947, a Ministry of Agriculture report suggested that in order to increase food production to meet the

[4] The Ford Foundation report strongly reflected the Malthusian thesis on overpopulation amongst the poor and developing countries being the prime cause behind poverty. It did not mention the structural constraints that led to unequal land ownership and land reform movements across the world as a major determinant of poverty.(Ross 1998).

needs of the "growing population," greater attention needed to be given to minor irrigation works, use and development of local manures, distribution of improved seeds and plans for production of fertilizers (Ministry of Food and Agriculture 1957). With the growing support from policymakers, and the advice of the Ford Foundation, in 1959, the Intensive Agricultural Development Program (IADP) was launched in the most naturally endowed agricultural districts of the country. The IADP program featured a package that included a dose of improved seeds and implements, a balanced dose of fertilizers and pesticides, and recommendations for better soil and water management (Pearse 1983).

In 1964, a World Bank mission visited India and managed to impress further C. Subramanium, the Food Minister at the time, with the idea that a technological strategy with incentives to maximize profit for the individual cultivator was the only means to increase food production in India (Frankel 1978). The Green Revolution strategy found support not only within certain sections of the government, such as Shastri and Subramanium, the Prime Minister and the Agriculture and Food Minister, but also in the interests of the class of landed peasants who were powerful in state and local level politics. Rural notables such as Charan Singh, who had blocked an earlier resolution on land reform (Rudolph and Rudolph 1987), did not oppose this strategy. The Green Revolution package was also well supported by the Indian business class (Chibber 2003).

With Subramanium's influence, the importance of increasing agricultural production was addressed by Prime Minister Lal Bahadur Shastri at the level of national policies. In his speech to the nation on All India Radio in 1964, Shastri noted, "The basic question we have to address ourselves is of increasing food production" (Shastri 1986a, 22). Agricultural development occupied center-stage in national policy, even if it was because of the imperative of increased food production. The

stated aim of the national policy was to make the agricultural production process "predictable, safe and remunerative" for the rice and wheat farmers who would then have an incentive to increase production (Shastri 1986a, 88).

A speech of Lal Bahadur Shastri, "The New Agricultural Strategy," is particularly illustrative of the roles that farmers would play in the agricultural production process: "My brother kisan [peasant], I am appealing to the cultivators of India to the 300 million cultivators of my own country men, who will be in 0.6 million villages. I am appealing to them at this critical juncture to do everything possible to increase the output from its fields." To raise the political importance of agricultural development, Shastri coined the slogan "Jai Jawan, Jai Kisan" (Hail Soldier, Hail Peasant), putting agricultural issues on the same forum as the defense of the country (Shastri 1986a, 66). Political will on the part of the state to boost food production and to make farmers an important part of this process was a central tenet of the Green Revolution. Shastri died in Tashkent, Uzbekistan in 1966. Faced with a precarious food situation, which made the need for American aid crucially important, Indira Gandhi, the next Prime Minister, was forced to follow the economic policies of Shastri (Malhotra 1989) and adopt the Green Revolution package. To prevent the mass starvation, other alternatives such as distribution of land through land reforms, a less capital intensive form of technology, and even a better functioning system of food zones could have been considered. However, these were not explored as the Green Revolution solution appeared to give quick results. It was only later that its economic and ecological costs became known.

Green Revolution Technology: The Package

The Green Revolution technology consisted of man-made varieties of wheat and rice. Dwarf and semi-dwarf varieties of plants were produced as a result of plant

breeding processes designed to result in stable new varieties of plants having desired qualities, chiefly, higher yields on shorter, stiffer stems to combat lodging. In conventional plant breeding, genes can only be transferred within the same or closely-related species. The nature of seeds is such that the High Yielding Variety (HYVs) or hybrids do not produce sterile seeds; the genetic unpredictability of second-generation HYV seed means that it does not perform as well as parent seed and it cannot be planted the following season. The second (F2) generation of HYV seed, while not biologically sterile, is economically unusable as seed and produces 20% to 40% less yield than the first hybrid (Mumbaku 1998).

The Green Revolution varieties were designed to provide higher yields in comparison with traditional varieties, when used in association with inputs like chemical fertilizers, tractors, pesticides, controlled water, threshers, tractors and electric and diesel pumps (Parayil 1992). The importance of inputs is such that without their use, HYVs do not produce more than the traditional varieties and in fact can produce less (Kumbamu 2006). The architecture of the plant was such that more of the nutrients went into the production of the grain itself. The stockier and robust build of short-stemmed plants enabled them to support heavier grain clusters without lodging and withstand high winds or rough treatment at the hands of reapers. These varieties could be given larger varieties of fertilizers without running the loss of slender varieties (Pearse 1983). Chemical pesticides control the intensified onslaught of pests and disease and the weeds are controlled with increased use of fertilizer (Pearse 1983). Another important feature is the time bound-nature of operations and tighter crop rotation (Byres 1982).

Policy and Institutional Support

The Green Revolution technology was not simply a technology: the term refers to the dissemination and adoption of a technology (Roy 1987). While the increasing yields of the Green Revolution, poverty alleviation and nutritional gains are widely considered to be a result of HYVs (Lipton and Longhurst 1989, Pinstrup-Anderson 2001, Swaminathan, Borlaug 2000),[5] the role of state institutions in creating an environment to make profits or gains for farmers was key to the success of Green Revolution technology. Agricultural economists have elaborated on the role of state measures in increasing total factor productivity in the success of Green Revolution technologies. These measures included input subsidies for power, fertilizer, credit and irrigation works. They also included marketing and procurement mechanisms. In fact, investments in agricultural research, extension, irrigation, credit, and smallholder development programs made India's agricultural research systems one of the largest public funded systems in the world (Evenson, Pray and Rosengrant 1999). What has not been noted by plant breeders and agricultural economists is the fact that the state-facilitated institutions and policies allowed a positive business environment to be created for adoption of new technology and "certainty" in making gains or profits from this technology.[6] The state directly created a non-risky environment through

[5] For instance, Pinstrup Anderson (2001) notes that "in the 1950s, two leading American philanthropic institutions, Ford and Rockefeller Foundation, spearheaded the development of techniques and crops capable of producing the results industrialized countries had achieved in several generations. The results of these packages were soon visible. Farmers and their families ate better, sent more children to school, and built better homes. As new crop varieties became more widely used, the average yield rose steadily, just as it had done in the industrialized countries." However, a review of larger Green Revolution literature, particularly that written by sociologists, political scientists or even government reports shows the importance of the role of state support in farmers' improved incomes (IFPRI 1999). Besides, Lipton (1977) in illustrating the concept of "urban bias" highlights the importance of national policies that favor urban areas over rural ones as the root cause of continuing poverty, which shows the importance of considering the role of the state in the whole debate. See Michael Lipton. Why Poor People Remain Poor: Urban Bias in World Development. Cambridge, Masachusetts. Harvard University Press, 1977.

[6] For instance, Raina (2003) writes that the Green Revolution model is a state promoted model that allows risk proofing through assured irrigation, chemicals and fertilizers, and high yielding varieties

incentives and subsidies for productive investment by farmers that led to increased agricultural production and also helped them make profits from the new technology.

Research and Extension: The major breakthroughs in yield potential that kick started the Green Revolution came from conventional plant breeding approaches. Plants of different genetic backgrounds with desirable characteristics were crossed. Selecting from among the progeny, individual plants with desirable characteristics repeated over several generations, resulted in plants and varieties with improved characteristics such as higher yields, improved disease resistance and improved nutritional quality. The yield potential for the major cereals has continued to rise at a steady rate after the initial dramatic shifts in the 1960s for rice and wheat.

To implement the Green Revolution experiment, a number of land grant universities were initiated with funds from the United States Agency for International Development (USAID). Many of these Indian universities were modeled after the land grant institutions of the United States. The national agricultural research systems (NARS), particularly the Indian Council of Agricultural Research (ICAR) and Indian Agricultural Research Institute (IARI) were responsible for the modification of the new seeds that were imported from Mexico in 1965. The Rockefeller Foundation helped fund the development of the NARS even before the Green Revolution was introduced (Parayil 1992). HYV seeds were initially distributed at subsidized costs (Parayil 1992). Table 3.1 shows a steady increase in public sector research and development funds for agriculture between 1960 and 1990.

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were the hallmark of the Green Revolution technologies. Still, she does not mention that the state shared the risk with farmers or created appropriate conditions for the Green Revolution technology to give appropriate benefits.

Table 3.1: Public Sector Research and Development Funds

Year	Public Expenditure in Million USD per Year (in 1980 USD)
1960	70
1965	113
1970	114
1975	158
1980	194
1985	274
1990	421

Source: Evenson, Pray and Rosengrant (1999)

The wheat varieties that were released in India were pure line selections from the International Maize and Wheat Improvement Center (CIMMYT) crosses. The main role of Indian wheat breeders was to conduct field tests to ensure that the Mexican varieties could produce high yields under Indian conditions of soil, climate, pests, and diseases and to select varieties that would fit Indian tastes. In 1966–70, foreign varieties consisted of 40% of all varieties released in India (Indian wheat breeders at ICAR had also been releasing varieties prior to the release of HYV varieties). After that, Indian wheat breeders replaced foreign varieties with varieties that they developed through their own crossing programs. As a result, between the years 1966–70, 15% of Indian varieties had two Indian parents, 71% had an Indian parent and a foreign parent, and 14% had two foreign parents. In 1986–91, 36% of the crosses had two Indian parents, 57% had an Indian and a foreign parent (mostly from CIMMYT), and 7% had two foreign parents (Evenson, Pray and Rosengrant 1999).

While it would be hard to get cost estimates, the Indian scientific establishment invested significantly in the modification of the imported wheat varieties to make them suitable for Indian field conditions, both financially and technologically. A similar experiment was carried out for rice, at the International Rice Research Institute (IRRI), in Phillipines.

The Indian state instituted a large demonstration program to adopt the new HYVs or hybrids. To start with, a massive public information campaign and a thousand small demonstration programs were launched in 1965 to convince the farmers to switch over to new technologies. In the demonstration plans, a minimum of two hectares of each selected farm field were kept out for application of new technology (Parayil 1992). These parcels of land were entrusted to the new extension officers and agricultural scientists who demonstrated the effectiveness of this technology as a model farm for the community. In case the new technology did not provide a bumper crop, provision was made to compensate the farmers (Parayil 1992). Other state measures also included setting up new institutions like the National Seed Corporation, the National Co-operative Development Corporation, the Agricultural Re-Finance Corporation, and several Central and State government corporations to supply modern inputs to the cultivators (Bhalla 2007). In addition, seeds were supplied to farmers at very low rates while the cost of using the Green Revolution seeds was high.

Minimum Support Prices and Procurement Mechanisms: Appropriate pricing and procurement mechanisms for increasing the supply of food grains were an integral component of the Green Revolution strategy. Minimum Support Prices (MSPs) would compensate for the greatly increased production costs and risks involved in the adoption of the new technology. These policies were announced in advance of sowing as a way to guarantee and encourage maximum production efforts (Pearse 1983) and act as a pricing mechanism that did not allow grain prices to fall below a certain level. Through the MSPs, the state continues to engage in regulation, distribution, pricing and procurement of food grains to balance consumer's welfare against the provision of good incentives for increased production by cultivators (Pearse 1983). While the MSPs date to an earlier period of time in the 1950s and were

initially established for only two commodities, today they extend to about 24 commodities (Acharya 1996).

For setting MSPs, the Indian state established the Agricultural Prices Commission (APC) in 1956.[7] Simultaneously, the Food Corporation of India (FCI) was established for procurement, storage, transport and distribution of food grains, along with a network of state market yards to enable profitable sale of these grains. The FCI would purchase food grains in government regulated markets, in local markets and FCI collection centers, and sell them to state governments, district collectors, authorized dealers or fair price shops (Pearse 1983).

Another major policy and institutional initiative introduced during the Green Revolution was the strengthening of the public distribution system (PDS) to supply surplus food grains to consumers, generated as a result of the new technology, state efforts and farmers' participation. While the origins of the PDS date back to the Second World War and the 1947 Bengal famine in the post-independence period, the system was still based on imported food grains. It was only after 1966, due to the advent of the Green Revolution, that greater procurement of food grains began to take place (Mooij 1999). The PDS that operated as a joint enterprise of the central and state governments works to achieve several specific objectives simultaneously including coping with emergency situations and distributing food at fair prices. The PDS allowed the creation of buffer stock that made India independent of food imports in the 1970s (Rao 1991).

[7] The APC was later transformed into the Commission of Agricultural Costs and Prices in 1985 (see Acharya).

Social, Economic and Ecological Effects of the Green Revolution Technology

Green Revolution technology combined with large increases in fertilizer consumption and irrigation led to an overall increase in production of food grains in India. Production rose from 95 million metric tonnes in 1967–68 to 130 million metric tonnes in 1980–81, an increase of almost 36% (Evenson, Pray and Rosengrant 1999).[8]

Economic Costs of the Green Revolution Package: While the hi-tech strategy led to an increase in the buffer stocks of food grains and ultimately to India's independence in terms of food production, it is also important to note that the Green Revolution package was very expensive. The cost of the inputs of plant protection, chemicals and fertilizers was 247,500,000 USD[9] for the period of 1966–1971 while the total amount allocated to agriculture during the period of the Third Five Year Plan (1962-1967) was only 42,444,444 USD.[10] The rest of the package cost was met through a shift in priorities in the allocation of foreign exchange and foreign private investment (Frankel 2005). Necessary inputs were made available at the expense of scarce foreign exchange (Pearse 1983).

State capacity for producing fertilizers, pesticides and tractors, the necessary mechanical and biochemical inputs, was limited initially. The state faced a tough ordeal in procuring them as America withdrew foreign aid (Frankel 2005). The private sector, especially the foreign private sector, provided the necessary mechanical and biomedical inputs at very high costs (see Postgate 1974). Table 3.2 shows the changing nature of tractor and fertilizer imports versus their domestic production

[8] Percentage Increase = 130-95/95*100=36%.

[9] 1114 crores= Rs. 11,120,000,000/45= 247,111,111 USD

[10] 191 crore= Rs. 191,000,0000/45= 42,444,444 USD

between 1961 and 1990. Prior to 1961, all tractors were imported (Evenson, Pray and Rosengrant 1999), and in 1961, the production of tractors was 880, much lower than its imports, 2,997. As Table 3.2 shows, after 1961, domestic production of tractors increased while imports continued. By 1985, imports of tractors ceased. In the case of fertilizers, 179,000 million metric tonnes or 44.86% of all fertilizers were being imported in 1961. Fertilizer imports peaked around 1985, when 3,625,000 million metric tonnes or 40.91% of all fertilizers continued to be imported.

Table 3.2: Import and Production of Tractors and Fertilizer in India (1961–1990)

Year	Tractors		Fertilizers (1000 million metric tonnes per year)	
	Imports	Production	Imports	Production
1961	2,997	880	179	220
1965	1.989	5,714	498	357
1970	12,032	20,009	633	1,061
1975	2	33,146	1,041	2,340
1980	5	67,627	2,759	3,005
1985	0	84,967	3,625	5,235
1990	NA	NA	2,754	9,044

Source: Evenson, Pray and Rosengrant (1999)

All in all, the state initially invested heavily in the Green Revolution package, with assistance from United States Agency of International Development (USAID) and the Ford Foundation. The role of farmers' direct investment in the new technology has to be regarded as well,[11] exemplified by the fact that the number of private tube wells increased from 0.1 million in 1961 to 0.47 million in 1971 (Dantwala 1975). Viewed from 1950–1960, the amount of resources that was spent both by the state and by farmers for adopting the Green Revolution package was high, especially in light of the increasing cost of cultivation in the 1980s.

[11] Interview, Raj Gupta, CIMMYT, Pusa Institute, Delhi, April, 2006.

Sharing the Benefits of Increased Productivity: The Green Revolution package was neither scale-neutral nor was it equally accessible to all regions or classes of farmers. The Ford Foundation (1959) report had already recommended that technological packages be implemented for select regions and for crops that displayed the highest potential for rapid increases in food production.

Access by Region: The HYV technology was responsive to intensive application of water. The geographical distribution of High Yielding Varieties (HYV) adoption followed a pattern in which adoption of HYVs was higher in better irrigated states. Table 3.3 illustrates the area under HYVs and area irrigated by state.

Table 3.3: Area Under HYVs, Irrigation and Fertilizer Use (1970-77)

States	Percent Cropped Area Sown With HYVs (1970)	Percent Cropped Area Irrigated (1970)	Fertilizer Use Per Unit Area (metric tonnes[12]/ha) (1977)
Andhra Pradesh	11.93	30.37	0.04
Bihar	14.16	27.52	0.03
Haryana	20.45	39.69	0.03
Maharashtra	15.21	8.45	0.02
Punjab	55.81	74.47	0.07
Tamil Nadu	37.00	45.56	0.05
Uttar Pradesh	35.99	38.46	0.04
Gujarat	14.90	13.72	0.03
West Bengal	12.42	20.34	0.02
Assam	6.13	8.67	0.01
Kerala	27.90	21.80	0.03

Source: Column 1 and 2 are from Fan, Hazell and Thorat (1999). Column 3 is taken from Prahaladachar (1983)[13]

[12] 1 metric tonne=1000 kgs. Here kgs/hectare has been converted into metric tonnes per hectare.

[13] Fan, Hazell and Thorat (1999) at IFPRI have obtained this area from state statistical abstracts and published government data.

As Table 3.3 shows, it was in the northern states of Punjab (55.81%), Uttar Pradesh (35.99%), and Haryana (20.45%) as well as some of the southern states like Tamil Nadu (37.00%), where the maximum adoption of HYVs took place by the year 1970. These were also the places where irrigation arrangements were concentrated. According to Table 3.3, the northern state of Punjab already had irrigation coverage of 74.47% when the new technology was introduced while Tamil Nadu had 45.56% irrigation coverage. Although its hard to say anything about fertilizer use, Punjab was also the state in which fertilizer use was highest. Incidentally, these were also the regions or states where the rich peasant stratum was already established as a class (Byres 1982). In states such as Assam, both HYV adoption and percentage of area under irrigation were low. As Table 3.3 indicates, in the case of Assam, the percentage area under irrigation was 8.67% and adoption of HYVs was 6.13%.

Access to New Technology by Class: At the outset, these package components were only accessible to the "progressive" farmers who were chiefly owners of large farms (Byres 1982, Pearse 1983) favored by access to capital, education and technological know-how and links with bureaucracy (Pearse 1983). These so-called new entrepreneurs, whom economic historian Daniel Thorner (1976) calls "gentlemen farmers," belonged to the urban moneyed class which already possessed the resources to take advantage of the new technology.[14]

What kind of access did small cultivators or tenants have to the new technology and to what effects? Griffin (1977) suggests that in underdeveloped countries, landlords and tenants or small holders face very different price structures. The economic power of the landlords ensures that large landowners receive more

[14] Thorner (1976) uses the term "gentlemen" farmers to denote the in surge of urban interests in agriculture in the initial days of the Green Revolution. On the other hand, authors such as Pearse (1983) largely use the term "progressive" farmers to denote those farmers who had better access to material, institutional and political resources that allowed them to make gains from the Green Revolution technologies.

agricultural inputs at less than their social opportunity cost while tenants or small holders tend to pay more than the cost for land and inputs and receive less than the actual social opportunity cost for their labor. The new technology, which was already biased towards the large landowners, meets these unequal social structures.

Drawing from a number of Indian case studies, Pearse (1983) at United Nations Research in Social Development (UNRISD) writes that large landowners, in many cases, became direct producers themselves after seeing the profits in farming, dismissing their tenants and taking their land under direct cultivation (reverse tenancies). In other cases, landowners changed the form of tenancies, so that profits could only accrue to them. The small farmers, whose ability in adopting new technology were constrained by their lack of political influence, access to land, and inputs such as water supplies or tractor power as possessed by large landowners, found themselves in unequal competition with those who possessed the same. In the case of small farmers, the Green Revolution package asked for too many changes in their existing technology all at once, leading to a higher cost of production for the small cultivators than the large landholder farmers. Already in debt from pre-harvest consumption and for occasional ritual obligations, the small farmers faced the necessity of increasing their indebtedness if they had to adopt new technology. According to Pearse (1983), this situation implies that the number of small farmers was either stable or declining, or small farmers were forced to complement their own production with other income, from sale of labor to other farmers, through trade or from migrant labor to cities. Pearse further suggests the result was that subsistence agriculture declined to a point till it was no longer providing subsistence. While movement out of agriculture could be counted as a positive trend, this is only when alternative labor opportunities existed. In India, alternative occupations were so few in number that they are insufficient to absorb the increase in urban population.

The effects of the Green Revolution technology on Indian agriculture were also considered in Marxist circles. Patnaik (1976), a Marxist economist, highlighted the growing gap between the labor-hiring and non-labor hiring classes in technology adoption and the ensuing class differentiation and proletarianization in Punjab. She argued that the labor-displacing effects of the new technology and poor returns to the laborer class due to a decline in real incomes added to the process of class differentiation (Patnaik 1976) and class polarization (Omvedt 1981, Byres 1982). Byres (1983) reported that the numbers of agricultural laborers increased when the new technology was being adopted.

In the Marxist discourse, claims were made even before the advent of the Green Revolution that it would turn into a red one (Sharma 1973). Frankel (1971) warned that the introduction of new technology in an unequal society could lead to class conflict.

Studies conducted in Haryana districts indicate that small farmers faced constraints in adopting new technology such as a lack of an adequate water supply, high prices of fertilizers and chemicals and lack of institutional credit, and these circumstances led to an increase in taking credit from informal sources at high interest rates (Prahaladachar 1983). Large farmers had better bargaining power and stocking capacity over small farmers that allowed them to get better prices for their produce (Dantwala 1979). Given that the package also contained power subsidies that favored use of tube wells, there was a shift from public to private irrigation systems. Access to tube wells was available to those who owned land, which exacerbated the inequality arising from unequal land endowments (Rao 1991). Benefits from subsidies, such as electricity, irrigation and fertilizers, were directly related to size of land holdings and other productive assets leading to greater benefits for large farmers (Rao and Storm 1998).

In contrast, Johl (1975) believes in the success of the Green Revolution technology, suggesting that while large farmers gained the most from the Green Revolution (9–14 hectare), the small farmers (0.1-2 hectares) were not phased out. Johl notes that reverse tenancies were not evictions of tenants and that it takes a generation to change professions. Although the Marxist view is distressing, driven by a crisis scenario, and Johl's view is hopeful, driven by faith in technology, the reality lies somewhere in between. It would be safe to assume that while the Green Revolution was originally designed to support large farmers, small farmers gained as well, although through a "trickle down." This is not to say that all farmers and agricultural laborers gained equally. The Green Revolution also benefited plant breeders, fertliser producers, agricultural institutions, as a cadre of government bureaucracy was created for the adoption of new technology and the disbursement of food.

Rural Tensions, the Second Phase of the Green Revolution and the Political Motors of Redistribution: Increasing inequality in the country due to biased Green Revolution policies and rural violence forced the state into action. When political violence erupted at Naxalbari, West Bengal in 1967, fears of class polarization and rural revolt strongly influenced state intervention in the second phase of the Green Revolution. A 1969 Home Ministry Enquiry into the causes of rural violence noted unequal access to technology as a prime cause of rural unrest. This led Union Home Minister Y.B. Chavan to declare in 1968: "Unless the Green Revolution is based on social justice, I am afraid it might not remain green" (cited in Desai 1983). A number of government policies were instituted in the next ten years to make more equitable the distribution of gains from Green Revolution technology. The new theme of the state's policy was "remove poverty" and the creation of a pro-poor strategy. The growth in GDP had not enabled the poor to benefit from development, so how to make

the poor better off and more productive became a new goal of the Indian state (as well as World Bank policy intellectuals) (Rudolph and Rudolph 1996).

As a consequence, the Indian government also created schemes to foster a second Green Revolution in the eastern region of India through a package of non-economic incentives such as distribution of fertilizers and certified seeds, extensive market networks, sales outlets and regulated markets for the purchase of outputs (Gulati, Hanson and Pursell 1990). The initiatives of the state led to the wider spread of Green Revolution technology in the Indo-Gangetic Plain in the eastern states of Bihar and Bengal as well as western ones such as Gujarat (Farmer 1977).Table 3.4 indicates the spread of HYVs in various states of India from 1970–1995.

Table 3.4: Percent of Gross Cropped Area under HYVs

Year	Andhra Pradesh	Haryana	Gujarat	Punjab	West Bengal	Bihar
1970	11.93	20.45	15.21	55.81	12.42	14.16
1975	40.01	51.64	19.31	71.78	18.52	21.66
1980	42.15	65.29	40.67	78.71	36.83	34.40
1985	58.74	74.87	56.50	94.56	39.86	35.81
1990	72.87	79.63	68.71	93.55	45.01	36.03
1995	82.69	75.73	73.71	89.45	54.91	44.43

Source: Fan, Hazell and Thorat (1999)

As is evident from Table 3.4, while HYVs continued to spread more completely in Punjab and Haryana, the spread of HYVs picked up in Gujarat and West Bengal after 1980s. In the initial Green Revolution areas of Punjab, the area under HYVs increased from 55.81% in 1970 to 78.71% in 1980 and to 89.45% in 1995. In the case of Gujarat, area under HYVs increased from 15.21% to 40.67% between 1970 and 1980 and from 56.50% to 73.71% between 1985 and 1995. Similarly, in the case of the eastern state of West Bengal, the area increased from 12.42% in 1970 to 36.83%

in 1980 and 54.91% in 1995. In the eastern state of Bihar, the area under HYVs increased from 14.16% to 34.40% between 1970 and 1980 and to 44.43% in 1995.

State intervention during the late Green Revolution period allowed crops, farms and states (such as West Bengal), falling behind in adoption of HYVs, to catch up to some extent (Rao and Storm 1998). Another remarkable feature of the second phase of the Green Revolution was the introduction of a social safety net, including employment generation schemes and poverty alleviation programs for the small and marginal farmers in non-Green Revolution areas. Other programs introduced were the Small Farmers Development Agency (SFDA), the Marginal Farmers and Agricultural Laborers Assistance Scheme (MFAL) and the Drought Prone Assistance Program (DPAP) (Frankel 2005). The scale of these programs was unprecedented. While the extent of reducing rural poverty can be debated, these programs did have a positive effect on poverty reduction (Byres 1997). Rao and Storm (1998) find that the decline in rural poverty can be attributed to the effects of these government interventions rather than egalitarian tendencies of the Green Revolution technology.

Regional Disparities, Uneven Growth and Neglected Regions: The Green Revolution did not erase regional disparities in growth and development amongst states. According to economists Rao and Storm (1998), the decade of the 1960s was a decisive period in setting the pace of regional growth in India. Both inter-state and intra-state disparities in overall growth performance were broadly related to the development of agriculture and the growth of irrigation, electricity, transportation and credit. During the first period of the Green Revolution, the inter-state disparity in area cropped per person declined, neutralizing the shrinkage in spatial variations in land productivity. The underlying reason for this disparity was the strong negative correlation between land yields and the land-person ratio. The first period of

agricultural growth had a relatively broad spatial base and succeeded in productively absorbing rural surplus labor (Rao and Storm 1998).

During the second period of the Green Revolution, regional disparities in terms of productivity per hectare and per capita output increased, implying that compensating changes in the regional pattern of person-land ratio were absent (Rao and Storm 1998). In this period, there was also a decline in land use intensity and slow growth in agricultural employment. In the second period, food grain growth picked up significantly in the Eastern regions, where it had been slow in the early period of the Green Revolution (Rao and Storm 1998). Per capita food grain production grew by 45% from the early 1960s to 1980s in the northern region comprised of Punjab, Haryana, Uttar Pradesh, Himachal Pradesh, and Jammu and Kashmir. In all other regions of the country (encompassing three quarters of the nation) per capita grain production has declined or stagnated. Food deficit states have suffered a larger decline in food consumption per capita due to a large rise in food prices. States with food surpluses experienced more non-agricultural growth and sectoral shifts in output and employment than deficit states (Rao and Storm 1998).

The distribution of gains across farm size classes continues to be a controversial issue (Rao and Storm 1998). While some believe that there has been no long term trend in increasing rural inequality (Ravallion and Dutt 1995 cited in Rao and Storm 1998), others (Ahluwalia 1978 cited in Rao and Storm 1998) have concluded that the growth of agricultural GDP attributable to the use of new technology is having a more profound impact on lower income classes; it may also be helping to reduce rural poverty. In contrast, according to Rao and Storm (1998), who base their findings on Central Statistical Organization and National Sample Survey data, per capita expenditures on food in absolute terms did not exhibit a statistically significant trend. They argue that employment opportunities in the agricultural sector

had shrunk relative to the growth in the work force and that the rate of household savings has been highly concentrated. Combining these factors, it appears that rural inequality has increased over time. From 1955–56 to 1977–78, except in Punjab, Kerela, Haryana, Andhra Pradesh and western Uttar Pradesh, the real wages rates of male agricultural workers declined or remained unchanged (Rao and Storm 1998). In terms of crops, the Green Revolution was most successful in raising the crop productivity of wheat. The increase in productivity was limited in the case of the rice fields and technology had not yet sufficiently overcome problems set by the natural environment (Farmer 1977).

The Green Revolution did succeed in creating buffer stocks of food grains. By 1976 India was free of food imports (Rao 1991). However, the technology and the state intervention did not succeed in addressing food security by depressing food prices or addressing the poor socio-economic condition of farmers in rainfed areas. The crucial factor constraining long-term agricultural growth was poor progress in irrigation development, which has led to only 30% irrigation coverage over cropped area for all of India. The rest of the cropped area is still dependent on monsoon rains, leading to fluctuations in farmer incomes in rainfed areas (Rakshit 2004). According to Hanumantha Rao (2002), agriculture in rainfed areas has never received the attention in terms of research and policy action that Green Revolution areas have received. Unlike irrigated crops, rainfed crops face yield as well as price uncertainty, in addition to being less remunerative, and price support and procurement operations are highly inadequate in these areas (Hanumantha Rao 2002). Farmers are more distressed in rainfed areas specially amongst those who have used credit for switching from traditional low value crops to input-intensive high value crops (IWMI and CRIDA 2006).

Therefore, the second phase of the Green Revolution did not lead to an equitable distribution of gains. The role of state and public policy in attempting to engage in redistribution is important to recognize.[15] Recognition was growing that even within the National Agricultural Research Systems (NARS), technology was not the solution to poverty reduction. For instance, Dr. Tomar, a now retired wheat breeder scientist of the Indian Agriculture Research Institute (IARI) noted, "The poverty that I saw in many parts of India was so deep that we could not do anything about it. I wrote a book about it, but R.B. Singh who was the then President of Indian Agriculture Research Institute (IARI), told me why are you writing these things."[16]

Comparing the Green Revolution with GM discourse, the GM debate shows that while GM proponents make some reference to the role of political institutions such as the role of the nation state in determining the effects of new technology, this discussion is very limited in nature. It is mostly relegated to what incentives the state should provide for public-private partnerships, for producing cheaper GM seeds, or increasing its own capacities to produce GM technology (Zilberman, Ameden and Quaim 2007, Raney and Pingali 2007). Even those who call for faster implementation of biosafety regulations by the state (Pray, Huang, Hu, Wang, Ramaswami and Bengali 2006) do so in the context of lowering the costs of GM seed technology.

In this debate, a nuanced discussion of the role of the state in allowing small and marginal farmers to gain from new technology is completely missing. Also

[15] By the 1980s, the hidden costs of the Green Revolution package on the environment also became visible. Areas of intense use of dwarf varieties of HYV's witnessed a decline in the water table, water-logging and increase in salinity due to intensive tapping of groundwater resources (Shiva: 1991, Singh: 2004). The overuse of fertilizers led to a decline in soil fertility, led to contamination of water bodies and created soil toxicity and micro-nutrient deficiencies (Shiva 1991). The reduction in genetic base from which the new varieties are developed resulted in a gradual breakdown of plant resistance to plant attacks. New pest varieties were evolved leading to heavy crop losses (Shiva 1991). Monocropping systems, along with over use of pesticides and fertilizers, led to a decline in crop productivity by the 1980s.

[16] Interview, Dr. Tomar, Wheat Breeder, Mayur Vihar, Delhi, September, 2009.

missing is the critical discussion of the role of international institutions and the skewed nature of the international agricultural market. Those who promote GM crops suggest that despite the maintenance of agricultural subsidies of developed countries, adopting GM crops across all crops can bring gains for all nations (Gruere 2006). Not much consideration is given to power asymmetries in international commodity markets or to the fact that if overall productivity is high and international demand for agricultural commodities is low, the prices obtained by domestic producers will be low. The anti-GM activists who do consider the externalities of trade liberalization or the role of the World Trade Organization (WTO) on farmers' profits (Shiva 2005; Sahai 2006) do so in a very caricaturist manner and miss the nuanced mechanisms as to how international trade affects commodity prices. These issues will be dealt with in Chapter 6.

New Farmer Movements and the Sticky Gains of New Technology: A third important mechanism that allowed farmers to continue making gains from the Green Revolution technology was the agency and bargaining power of the farmer movements. There is considerable evidence to show that farmer movements helped wheat and rice farmers to continue to benefit from the new technology. For instance, Dr. Shailaja Sharma, the Director of the Commission of Agricultural Costs and Prices (CACP) contends that "the MSPs are set through negotiations with farmers groups."[17] The new farmer movements[18] called for setting MSPs and demands for increased subsidies for power, irrigation and fertilizers (Corbridge and Hariss 2000). Demands for agricultural loan waivers, reduced agricultural taxation and better terms of trade for agriculture were other important items on the agenda. Subsidies and procurement

[17] Interview, Dr. Shailaja Sharma, Commission on Agricultural Costs and Prices, CSE-NCF Roundtable, Delhi, July, 2006.

[18] The new farmer movements were different from the old farmer movements which primarily focused on land reforms.

prices controlled by the government were common issues that allowed various kinds of farmers to unite.

Byres (1982) writes about the upsurge of new farmer movements and notes that the progressive farmers who possessed better resources consolidated their economic gains by adopting Green Revolution technology, creating a "class-in-itself" ready for "class-for-itself" action. Similarly, Rudolph and Rudolph (1996) dismiss them as a "kulak" movement. Varshney (1996) has noted the presence of the agricultural laboring class as part of the agrarian movements along with rich and middle class peasants. However, it would be safe to say that these movements were comprised largely of rich farmers. Apart from debating the class composition of the new farmer movements, it is important to recognize that such farmer movements arose in many parts of India, mobilizing large numbers of people in Maharashtra, Uttar Pradesh, Punjab, Haryana, Karnataka and Tamil Nadu. The social movements that stood outside party politics in their early phases mobilized a large number of people and organized to resist and to make demands on the state (Corbridge and Harris 2002). The most prominent voice of the farmer movements was Charan Singh, a middle class peasant leader from Western Uttar Pradesh. Singh saw the interests of the urban industrial model articulated by the Indian state as antagonistic to the interests of agriculture and Indian farmers (Varshney 1996). This paradigm of an urban India versus a rural Bharat was followed up by the successive farmer groups such as Shetkari Sangathana in Maharashtra (led by Sharad Joshi) and Nanjunadswamy of the Karnataka Rajya Ryotha Sangha (KRRS),[19] both large peasant organizations.

Gaining strength as a political force, these movements (Varshney 1996) gave farmers a bargaining power through which they could lobby the government and

[19] Karnataka State Farmers Coalition

continue to get a good price for wheat and rice as well as to increase the rate of getting subsidies. The price-setting process had become heavily politicized with the growing power of the farm movements and the influence of the dominant producers of the marketed surplus. In the early Green Revolution period, the government allowed larger increases in the procurement prices than were recommended by the APC. Political protests by the farm lobby gained steam, especially when the FCI was gathering food stocks to support agricultural prices. Even while the grain prices declined in the second part of the Green Revolution, the principal effect of the protests was to prevent a collapse of grain prices (Rao and Storm 1998).

The power of the farmer's lobby was such that there was an explosion in government expenditure from 1978 to 1979, mainly relating to subsidies for food, fertilizers and exports. According to Joshi and Little (cited in Corbridge and Harriss 2002), the growth of the first two is related to the strength of the farm lobby combined with the desire of politicians to prevent unrest in cities. Food subsidies doubled from 1976–77 and again in 1984–85. There were large increases in power subsidies as well.

Table 3.5 shows the nature of subsidies that are available to the entire farm sector from 1980–1996. As Table 3.5 indicates, agricultural subsidies, especially power subsidies, have been increasing heavily between 1980 and 1996. In 1991, the total amount of agricultural subsidies constituted around 8.29% of the GDP, which shows the power of the farmers lobby in setting subsidies. By 1981, no government in India could afford to ignore the power of the rural lobby (Corbridge and Harris: 2002).

After 1991, most of these subsidies were being met through foreign borrowings. Apart from subsidies, the power of the farmer's movement was such that the Congress government in 1977 had to agree to favorable terms of reference to the Agricultural Prices Commission (APC). The movement asked for better farm prices to be calculated considering the terms of trade for agriculture vis-à-vis industry

(Lennenberg 1988). Sharad Joshi, the leader of the mass based movement of Shetkari Sangathana (Peasant Organization), was appointed to the CACP, which determines the MSPs for major agricultural commodities.

Table 3.5: Farm Subsidies in India from 1980–1996 (In Million USD)

Years	Fertiliser	Power	Irrigation	Credit	Total[20]	GDP	Percent of GDP[21]
1980-81	5.96	7.56	9.64	11.49	34.64	943.69	3.67
1985-86	22.69	21.84	18.78	23.51	86.82	1554.76	5.58
1990-91	51.69	107.64	45.38	44.16	248.87	3003.60	8.29
1995-96	60.62	252.20	39.29	60.09	412.20	5680.29	7.26

Source: Gulati and Sharma (2002)

Calls for better prices and other related issues were echoed in parliamentary debates during this period.[22] Leading the Bharatiya Kisan Union (Indian Peasant Organization), Charan Singh later formed a non-coalition government at the Center in the late 1980s. Agriculture became a central piece of the government budget in the 1980s (Byres 1982). The scale of the farm subsidies could not be sustained, as these were paid for by massive borrowings from Indian householders and abroad and from the accounts of non-resident Indians. They were not financed by taxes of newly rich farmers from north and west India who gained the most from the government's unwillingness to challenge the power of India or Bharat (the Hindu name for rural India). When a new government came to power in 1991 and wrote off the debts for small and not-so-small farmers, India's fiscal deficit doubled, precipitating an economic crisis (Corbridge and Harris 2002).

[20] Total subsidies are a sum of all subsidies.

[21] Percent of GDP=Total Subsidies/GDP*100.

[22] Author's cursory reading of Parliamentary debates between 1965 and 1991.

Persistence of Green Revolution Ideologies and Institutions

The Green Revolution in Rainfed Areas: Despite the bias of state policies in favor of irrigated agriculture in terms of research and infrastructural investments, rainfed agriculture is an important part of the agricultural sector in India (Kerr: 1990). Nearly 70% of agriculture in India is rainfed (Kerr 2006). Table 3.6 shows the area under different varieties of major crops in rainfed areas.

Table 3.6: Share of Rainfed Agriculture in Production by Area (1987–89)

Category	Share of Crop that is Rainfed (as Percent of Total Cropped Area)
Food Grains	65.40
Coarse Cereals	91.10
Pulses	90.20
Oilseeds	79.30
Cotton	69.10

Source: Kerr (1990)

Table 3.6 shows that a large proportion of food grains, coarse cereals and pulses are grown in rainfed areas. Hundreds of millions of poor rural people depend on rainfed agriculture as the primary source of their livelihoods (Kerr 1990). Rainfed areas in India are diverse, ranging from resource-rich areas with good agricultural potential to resource-poor areas with much more restricted potential; they include high-rainfall areas in the east and northeast and the dryland areas of the Deccan Plateau. Soil types also vary, as do infrastructure, human capital and other socio-economic factors. According to Kerr (1990), some resource-rich rainfed areas potentially have high agricultural productivity and have experienced widespread adoption of improved seeds. On the other hand, in drier, less favorable areas, growth in productivity has lagged behind, and there is widespread poverty and degradation of

natural resources (Kerr 1990). The increase in the rate of growth of agricultural productivity will have a significant bearing on the overall rate of agricultural growth and on the prospects of achieving greater regional balance in this growth (Kerr 1990).

While the Five Year plans have recognized the importance of the developing rainfed agriculture, incorporated a variety of programs for increasing agricultural productivity, scientific research for the rainfed areas, particularly dryland areas, has been governed by the norms of irrigated agriculture. The model that is being followed in the rainfed areas of India is the improved seeds-fertilizers-irrigation Green Revolution model (Raina 2006). A recent spate of farmers suicides shows that the Green Revolution model dependent on high levels of water use, assured irrigation, purchased inputs and reliable markets does not consider the limited resource availability and high inter and intra-seasonal variability that characterize rainfed agriculture (Raina 2006). Such rural development programs based on the Green Revolution model and private investments encourage the exploitation of groundwater for irrigation of water intensive cash crops in the rainfed areas.

Even after the potential for surface irrigation is exhausted, half of the land will be solely dependent on rainfall in India (Kerr 1990). This shows the importance of looking for sustainable agricultural solutions for rainfed areas.

Green Revolution in Development Ideology and Institutions: Even though the Green Revolution occurred between the 1960s and the 1980s, it continues to be an important event in development theory, the institutional ideology of major developmental institutions and hence development interventions planned, both globally and nationally. Major policy statements signify the persistence of these ideologies. For instance, the Secretary General of the United Nations, Ban Ki Moon, noted in the General Assembly meeting held for the 2008 global food and energy crisis, “Second, we must act immediately to boost agricultural production this year.

We do this by providing urgently needed seeds and fertilizers for the upcoming planting cycles, especially for the world's small-scale farmers" (UN 2009). This document represents the joint effort of both the United Nations and Bretton Woods Institutions. The importance of technology is also underscored in the integral web content of the Food and Agricultural Organization (FAO) in Rome, a major international organization: "Harnessing modern technology, may cultivate hundreds of hectares of high-yielding crops to meet the food needs of thousands of families on the other side of the globe" (UN 2009).

Similar statements have been made by other important dignitaries as well. In 2007, the Bill and Melinda Gates Foundation and the Rockefeller Foundation started spearheading a new initiative to counter poverty and food insecurity in Africa. Not surprisingly, this alliance was titled the Alliance for Green Revolution in Africa (AGRA). On the eve of June 2007, Kofi Annan, six months after his departure from the UN, was elected as a President of this Alliance. He noted,

> I join my fellow Africans in a new effort to comprehensively tackle the challenges holding back hundreds of millions of small-scale farmers in Africa. Africa is the only region where overall food security and livelihoods are deteriorating. We will reverse this trend by working to create an environmentally sustainable, uniquely African Green Revolution. When our poorest farmers finally prosper, all of Africa will benefit. (Annan 2009)

The mission statement of the AGRA suggests that the root cause of entrenched and deepening poverty is the fact that millions of small-scale farmers cannot grow enough food to sustain their families, their communities, or their countries. Thus, the solution to this poverty is to "focus on developing more productive and resilient varieties of Africa's major food crops, adapted to thrive in a variety of conditions. These will enable Africa's small-scale farmers to produce larger, more diverse and reliable harvests." A similar call is made in the Millennium Task Force Goals Reports, written to operationalize the millennium development goals. The first report, an

important document for the development community titled "Halving Hunger," suggests,

> In Asia, Latin America, and the Middle East, a Green Revolution tripled food productivity and helped lift hundreds of millions of people out of hunger. Africa has not yet had a Green Revolution of its own. This is partly because the scientific advances that worked so well elsewhere are not directly applicable to Africa. Here, we produce a wide and different variety of food crops. African farmers depend largely on rainfed agriculture rather than irrigation, leaving them vulnerable to climatic shocks. Given the right kind of national and international support, Africa can achieve the 21st–century Green Revolution it needs. What would such a revolution look like? Let us generate a uniquely African Green Revolution – a revolution that is long overdue, a revolution that will help the continent in its quest for dignity and peace. (UN Millenium Project 2009)

It is quite apparent that the seed-fertilizer-irrigation Green Revolution model of increasing agricultural productivity appears to be the common developmental intervention that is being planned in Africa.

The Gene Revolution as the Green Revolution

Many important players of the Green Revolution have referred to the adoption of transgenic technology as the "second Green Revolution." For instance, Gordon Conway, former President of the World Bank and an important figure in the international agricultural centers writes in his book the *Doubly Green Revolution,*

> The technologies of the Green Revolution were developed on experiment stations that were favored with fertile soils, well controlled water resources and other factors suitable for natural production. There was little perception of the complexity and diversity of farmer's physical environment, let alone the diversity of farmer's physical environments let alone the diversity of the social and physical environment. The new Green Revolution must not only benefit the poor directly but must be replicable in highly diverse conditions and be environmentally sustainable. In effect, we require a Doubly Green Revolution, a revolution that is more productive than the first Green Revolution, and even more green and we must try to repeat the successes of the Green Revolution. (Conway 1997, 22)

In a similar vein, Lipton (2006), an important agrarian studies scholar at Sussex, in an article titled, "Transgenic Seeds: Replicate the Success of the Green Revolution for the Poor," notes,

> Improved farm technology helps all main groups of the poor – small farmers, farmworkers and other low-wage labour – when it raises labour value-productivity, but raises land and/or water value-productivity faster; and cuts staples prices, but raises smallholders' total factor productivity faster. From 1965, the Green Revolution walked these two tightropes largely by luck. Though targeting bigger piles of rice and wheat, it cut poverty through consumption; nutrition; smallholder income; employment; risk reduction; and ecological sustainability. Yet large areas were left out, and from 1985 progress slowed. In the new environment for research and agriculture, how can transgenics revive and spread poverty reduction? (Lipton 2006, 32)

Further, Pingali and Ranney (2005, 2), of the Food and Agricultural Organization (FAO) postulate the Gene Revolution to be a successor to the Green Revolution:

> The past four decades have seen two waves of agricultural technology development and diffusion to developing countries. The first wave was initiated by the Green Revolution in which an explicit strategy for technology development and diffusion targeting poor farmers in poor countries made improved germplasm freely available as a public good. The second wave was generated by the Gene Revolution in which a global and largely private agricultural research system is creating improved agricultural technologies that flow to developing countries primarily through market transactions.

In a similar statement, Fukuda Parr of United Nations Development Program (UNDP) writes that "the high-yielding selective breeding technology of 'the Green Revolution' of the 1960s and 1970s is now being overtaken by 'the Gene Revolution' — the development and spread of GM crops across the world" (Fukuda Parr 2006). Likewise, a call is made for a "uniquely" Green Revolution by the UN Secretary General Kofi Annan to increase the productivity in agriculture in Africa. In support of these measures, the Alliance for a Green Revolution in Africa (AGRA) was established in 2006 to achieve a smallholder-based African Green Revolution that will enable Africa to be food self-sufficient and food secure (AGRA 2009).

While this chapter identified the factors under which small and marginal farmers gained from Green Revolution technology, persistence of Green Revolution ideology in development institutions and the comparision between Green Revolution and Gene Revolution in development discourse, chapter 4 will focus on the ecological and economic condition of cotton farmers to better understand the gains of farmers from the adoption of GM cotton.

Chapter 4

CONDITION OF COTTON FARMERS IN VIDHARBHA

When the new Bt cotton seeds began to sell in Shiras's seed shop in Yavatmal district center, Vidharbha, a farmer known as Ayya Baheru Atram, immediately decided to buy them. If rain were to come in 2006, he would be able to ameliorate his debts by buying these new seeds. He already owed the local moneylender 89 USD on which he was being charged 120% interest per year. The seed seller had promised him a greater yield from the new seeds because they did not require pesticide applications. The earlier hybrids that he had planted required so many doses of pesticides that he had to take extra loans every season. His neighbor, Ganpat Naitam, had used the new Bt seeds the last cropping season, and his cotton bolls did not suffer from pest attacks, unlike the regular Ankur hybrid. Atram was not alone in his expectations and distress. Most farmers in the Vidharbha region had high hopes for the new Bt seeds. Some were even eager to buy the spurious or fake seeds,[1] whose markets were flourishing in both Maharashtra and nearby cotton growing states, when they could not afford the branded seeds.[2]

Even though Maharashtra has the largest area under cotton in India, cotton productivity in the state has been historically low and uncertain. Located in the semi-arid Deccan Plateau, most of Maharashtra, including Vidharbha, faces acute water scarcity, a prime cause of low and fluctuating cotton yields and associated farm incomes. Fragmentation of land holdings, a growing monoculture of cotton and

[1] Seeds that are sold in the name of Bt cotton but do not contain the genetic modification trait that is required to reduce pesticide sprays.

[2] Story created from readings from various news reports. For instance, see reports by P. Sainath and Jaideep Hardikar: Accessed at: http://www.indiatogether.org/opinions/psainath/ and http://indiatogether.com/2005/jan/agr-vidarbha.htm

absence of diversification to non-farm activities over time has placed farm household incomes under stress.

While productivity and profits from cotton rose in the 1980s, due to the introduction of cotton hybrids, subsequent attacks of American bollworms led to a high dependency on pesticides. The rising cost of inputs, variable cotton prices, adverse marketing conditions, and the dismantling of the cotton monopoly procurement scheme have led to declining returns in cotton production. Increased dependence of farmers on moneylenders who charge high interest rates, due to the withdrawal of the state-supported from the rural credit system and the inadequate coverage of state supported safety nets such as the Maharashtra Employment Guarantee Scheme (MEGS) has led to further depressed farm incomes. Recent crop failures and subsequent farm suicides are symptomatic of the problems that farmers face.[3] In this Chapter, I describe the nature of these problems in Vidharbha. In conclusion, I ask whether these problems are symptomatic of larger agrarian distress in rainfed regions of India and the Indian agricultural sector at large.

Vidharbha, Dryland Maharashtra: The Location

Vidharbha is located in the eastern part of Maharashtra, central western India (See Figure 4.1). Located in an area of 97, 404 Km square, Vidharbha constitutes one third of Maharashtra in terms of area (IGIDR 2006). Vidharbha is made up of 11 districts: Nagpur, Wardha, Buldhana, Akola, Amravati, Bhandara, Ghadchiroli, Gondia, Chandrapur, Washim and Yavatmal.

[3] The Green Revolution literature indicates that the initial condition of farmers is an important determinant of farmers making gains from new technology.

Figure 4.1: Map of Maharashtra Showing Vidharbha

Source: Accessed at: http://milwaukeemasala.files.wordpress.com/2008/08/maharashtra-location-map.gif

Economic Conditions

The Economic Location of Vidharbha: Maharashtra is a model of economic progress among Indian states. It is the second richest state in terms of per capita income and stands first in contribution to national income among all Indian states

(Panda and Mishra 2005). The continuous growth of industry and employment, particularly in the area of sugar, textiles and finance in metropolitan Mumbai and adjoining regions is responsible for the economic progress of this state (Gokhale Institute of Politics and Economics 1983). Apart from its coastline, the rest of Maharashtra has been characterized by regional planners as an area of "agricultural backwardness" (NCAER 1963). Table 4.1 shows the workforce engaged in agriculture in Maharashtra between 1981 and 2001.

Table 4.1: Workforce in Agriculture in Maharashtra (1981–2001)

Year	Cultivators (as Percent of Total Workforce)[4]	Agricultural Laborers (as Percent of Total Workforce)[5]	Workforce Engaged in Agriculture in Maharashtra as a Percent of the Total Workforce[6]
1981	35.00	26.60	61.60
1991	32.80	26.80	59.60
2001	28.50	26.80	55.30

Source: Planning Commission (2007)

As Table 4.1 shows, the percent of the workforce engaged in agriculture in Maharashtra has decreased slightly between 1981 and 2001 from 61.6 to 55.3%. However, the share of agriculture in terms of the Gross Domestic Product (GDP) in Maharashtra declined from 24% in 1981 to 16% in 1999–2000 (World Bank 2003). The high concentration of the workforce in the agricultural sector combined with the

[4] Cultivators=Landowing Class

[5] Agricultural Laborers: Non-landowning Class

[6] Workforce Engaged in Agriculture=Cultivators+Agricultural Laborers

low GDP highlights the low income levels in the agricultural sector at the level of Maharashtra state (and Vidharbha). About 82% of Maharashtra districts, primarily those practicing agriculture, have a per capita income not only below the state average, but also below the national average (Planning Commission 2007). Table 4.2 shows the per capita income distribution (per capita district domestic product) across 11 districts in Vidharbha and the human development index in comparision with Mumbai, the capital city.

Table 4.2: Human Development Index and Per Capita District Domestic Product (PCDDP) in Vidharbha Districts

Districts	HDI (2000)	PCDDP in USD (1998-99)
Mumbai (city)	1.00	1,010.47
Buldhana	0.41	307.18
Akola	0.44	357.09
Washim	0.36	357.09
Amravati	0.50	381.51
Yavatmal	0.22	297.38
Wardha	0.49	376.71
Nagpur (major city)	0.71	641.73
Bhandara	0.46	321.49
Gondiya	0.46	321.49
Chandrapur	0.41	429.44
Ghadchiroli	0.21	380.89
Maharashtra	0.58	505.84

Source: Planning Commission (2007)

As Table 4.2 indicates, Vidharbha's rural districts have a very low per capita income as well as a low human development index (HDI) compared to Maharashtra's capital city, Mumbai or Nagpur city (a major city in Vidharbha). For instance, the HDI of Yavatmal district, one of the districts in Vidharbha that has been most affected by

suicide was merely 0.22 in 2000, and PCDDP 297.38 USD in 1998-99, in comparison to Mumbai (the index for HDI in 2000), where the PCDDP is 1,010.47 USD in 1998-99. Similarly, Nagpur has a HDI of 0.71 and PCCDDP of 641.73. Truly, "Maharashtra is split up into two segments, separate and unequal" (Sathe cited in Phadke 1998).

Land Tenure in Vidharbha: Table 4.3 shows the distribution of landholdings and the change in distribution of number and size of landholdings in Maharashtra from 1970 to 1996. As Table 4.3 illustrates, 69.96% (40.49+29.47) of the landholdings were under the small and marginal landholding category in 1995-96. A steady increase had been seen in the number of marginal (25.20–40.49%) and small landholdings (17.68–29.47%) from 1970 to 1996 in Maharashtra (as well as Vidharbha) in comparison to a reduction in number of large landholdings (10.38-1.14%). A similar trend is seen in examining the area under different types of landholdings. For instance, the area under marginal landholdings increased from 2.70-10.50% between 1970 and 1996. The area of large landholdings decreased from 40.10 to 9.49% between 1970 and 1996. This shows an increasing marginalization of landholdings. Consequently, Vidharbha's (and Maharashtra's) agrarian structure is characterized by the presence of a large class of peasant proprietors with small land holdings (Shah and Sah 1996). According to Ashok of Syngenta seeds, landowners in Maharashtra known as Patils (landowners) have become small farmers due to land fragmentation (not land reforms).[7]

[7] Ashok, of Syngenta seeds further adds, "These Patils are now only Patils in name. They do not have the kind of land that they had earlier or other sources of income. Still the dowry rates that they want to give are as high as 777 USD. Thus, their income is low and expenses are high" (Interview, Ashok, Syngenta seeds, Nagpur, July, 2006).

Table 4.3: Number and Area of Landholdings in Maharashtra (1970–96)

Size of Landholding	Number of Landholdings (in Millions)				Area of Landholdings (in Million Ha)			
Years	1970–71	1980–81	1990–91	1995–96	1970–71	1980–81	1990–91	1995–96
Marginal (upto 1 hectare)	1.24	1.92	3.27	4.26	0.57	0.93	1.60	2.00
Percent (of the total landholdings)	25.20	28.03	34.75	40.49	2.70	4.35	7.65	10.15
Small (1–2 hectare)	0.87	1.54	2.70	3.10	1.28	2.30	3.98	4.60
Percent of Total Landholdings	17.68	22.48	28.69	29.47	6.06	10.77	19.03	23.35
Semi-Medium (2–4 hectare)	1.08	1.68	2.10	2.10	3.10	4.80	5.88	5.80
Percent of Total Landholdings	21.95	24.53	22.32	19.96	14.68	22.47	28.12	29.44
Medium (4–10 hectare)	1.22	1.39	1.17	0.94	7.70	8.40	6.85	5.43
Percent of Total Landholdings	24.80	20.29	12.43	8.94	36.46	39.33	32.76	27.56
Large (above 10 hectare)	0.51	0.32	0.17	0.12	8.47	4.78	2.60	1.87
Percent of Total Landholdings	10.37	4.67	1.81	1.14	40.10	22.38	12.43	9.49
Total Land Holdings	4.92	6.85	9.41	10.52	21.12	21.36	20.91	19.70

Source: Planning Commission (2007)

Cropping Patterns in Vidharbha and High Dependence on Cotton:

Maharashtra is an important state for cotton production in India, cultivating about 3.15 million hectares of cotton, which accounts for 36% of India's total cotton area (Narayanmoorthy and Kalamkar 2006). Cotton constituted 14% of the gross cropped area in Maharashtra in 2001–2002 (IGIDR 2006). About 2,400,000 out of a total

12,000,000 cultivators are employed in cotton production in Maharashtra (IGIDR 2006) (comprising 20% of the total cultivators). Vidharbha is the major cotton producing area in Maharashtra. Vidharbha's eleven districts produce 75% of Maharashtra's cotton (Down to Earth 2006). Cotton production is the predominant crop of Vidharbha region, eastern Maharashtra (Planning Commission 2007). In 2006, 40% of the Vidharbha region was covered with cotton intermixed with soybean, tur (pulses) and jowar (millet) (Planning Commission/Government of India 2006).

Cotton, despite being grown by a large number of cultivators in Maharashtra, has not been an economically crucial crop compared to other cash crops (World Bank 2003). In terms of the contribution to agricultural growth and GDP, crops such as sugarcane, grapes and oranges are the major earners in Maharashtra's economy (World Bank 2003), even though Bombay was a major textile center of the region until the mid–1970s (Attwood, Israel and Wagle 1996), after which the price of cotton yarn and cloth dropped. A number of factors that led to the decline of cotton mills included a higher adoption of more efficient power-looms and the refusal of mill-owners to invest in modernization along with the rise in land values and a long mill workers strike in 1982 (Adarkar 2002).

Low and Fluctuating Productivity of Cotton: Despite having the largest area under cotton, the primary problem with cotton production in Vidharbha is its low productivity, both in current times and historically (IGIDR 2006; Planning Commission 2006). Average cotton yield in Vidharbha is 0.147 metric tonne/ hectare, which is extremely low compared to other states. For example, average cotton yield in the state of Punjab and Tamil Nadu is 0.366 and 0.295 metric metric tonnes/ hectare (Planning Commission 2007). Not only is the cotton yield low, but it also fluctuates.

Ecological Conditions

Water Scarcity: Cotton cultivation in Vidharbha has been traditionally practiced under rainfed conditions.[8] The low and fluctuating productivity of cotton in Vidharbha is largely tied to the scarcity and unpredictability of irrigation water (IGIDR 2006, Planning Commission 2006). Depending on the climate and crop-growing period, cotton requires 700–1200 mm of water per year (over its growing period) to meet its minimum water requirements. The water requirement is low during the first 60–70 days after sowing and highest during flowering and boll development (ICAR 2003). The first sowing of cotton in Vidharbha takes place in June and July. "Farmers buy crop inputs in advance of the monsoon showers in July."[9] The importance of rains in the agrarian economy in Vidharbha is suggested by the fact that most money lending operations occur around the monsoon season (IGIDR 2006).[10] If the rains are late, farmers resort to second sowings, which happen in late August or September.[11] Cotton production in Vidharbha is predicated on the timely arrival of monsoon rains, because late rains reduce the time available for boll maturation and hence productivity: "Rainfed cotton suffers from moisture stress during post monsoon season, which coincides with critical periods of flowering and boll development of the cotton flower" (ICAR 2007). The development of the cotton bolls, and cotton plant

[8] This fact is commonly referred to in most of the interviews I undertook: Hemachandhra Gajbhiye, Sociologist, Central Institute of Cotton Research, Nagpur, Maharashtra, July, 2006, Vijai Jaywandhia, Farm Activist, Shetkari Sangathana, Interview, July, 2006 and Pankaj Shiras, JK seeds, Nagpur, July, 2006. In fact, 65% of all cotton production in India is grown under rainfed conditions, which also leads to low yields. See Minstry of Textiles. *Annual Report, Ministry of Textiles 2007-2008*. Delhi: Government of India, 2008. Accessed at: http://texmin.nic.in/annualrep/AR07-08-01.pdf.

[9] Interview with Pankaj Shiras, JK Seeds, Nagpur, Maharashtra, July, 2006.

[10] According to the Indira Gandhi Institute of Development Research, a government-run institute, farmer suicides also tend to increase around this time (IGIDR: 2006).

[11] Interview with Pankaj Shiras, JK seeds, Nagpur, July, 2006.

productivity, is very much linked to water availability at critical stages of the plant's development.[12] The reasons for water scarcity in Vidharbha are manifold.

Rainfall: The Western Ghats, a chain of low lying mountains stretching along the coast, divide Maharashtra into a coastal zone blessed with heavy rainfall and a rain-shadow area called the Deccan Plateau (Gokhale Institute of Politics and Economics 1972). Vidharbha, located in the rain-shadow area, is an assured rainfall zone with a rainfall of 90 cm per year (Planning Commission 2006). Nevertheless, at times, the rainfall is low as has happened in 2001 and 2002 (Planning Commission 2006). Sometimes rains are late, as they were in 2004 (IGIDR 2006). Late rains or uncertainties in rainfall can have an effect on plant sowing and hence cotton productivity. An Indira Gandhi Institute of Development Research study[13] on Farmer Suicides (2006) notes: "Nearly 58% of reported suicide deaths were during monsoon months July-September with July and August having reported 71 and 70 cases respectively."

Even thoughVidharbha is largely a rain-assured region, 2004 saw below normal rainfall, and this situation had an adverse impact on the germination of cotton crops. In 2004, there were 89 cases of failed sowing — 37 for the first, 31 for the second, 20 for the third and 1 for the fifth sowing. Some of the suicides took place much after the failure of sowing. "It can also be inferred in some cases that the farmer went for a second/third sowing in late August/early September and a failure of fifth sowing in a tract that is totally rain dependent" (IGIDR 2006, 8). A large portion of Vidharbha is identified under the drought prone area program of the central

[12] Interview with R. B. Singh, National Commission of Farmers, July, Delhi, 2006.

[13] The Indira Gandhi Institute of Development Research study examined 36 cases out of a total of 644 cases of suicides spread over 12 districts in Vidharbha. A life history analysis was conducted.

government. The frequency of droughts in Vidharbha region is once in four years (Broken, Cracknell and Heathcoate eds. 2006).

Irrigation: Irrigation water in Vidharbha is available from two sources: groundwater (well irrigation and tanks) and surface irrigation works on small rivers. Table 4.4 shows the irrigation development in Vidharbha by source in 2001–2002 in comparision with other parts of Maharashtra. The irrigation development is indicated by revenue divisions. Maharashtra comprises of 8 revenue divisions, namely, Konkan, Nashik, Amravati, Nagpur, Pune, Latur, Kolhapur, and Aurangabad. Table 4.4 shows that Vidharbha is comprised of 2 divisions, Amravati and Nagpur. In the Amravati division,[14] where largely cotton is grown, the total area under under irrigation is 5.99% in 2001-2002. The Nagpur division,[15] although part of Vidharbha, has a higher percent of area under irrigation (15.88%) in 2001–2002. Irrigation coverage is much better in the case of other divisions. For instance, in the case of the Pune division, the area under irrigation is 24.36% and the Kolhapur division is 13.75%. What makes water availability scarce for irrigation in Vidharbha (groundwater and surface water), is elucidated in the following section.

Groundwater and Wells: The geology of Vidharbha plays an important role in shaping water scarcity. Geologically, Vidharbha sits atop the hard rock terrain of the Deccan Plateau, which comprises eighty percent of Maharashtra. The Deccan Plateau is covered by impervious lava flows, which makes Vidharbha a semi-arid region (Gokhale Institute of Politics and Economics 1983).[16]

[14] Districts Akola, Amravati, Buldhana, Washim, Yavatmal.

[15] Districts Bhandara, Chandrapur, Ghadchiroli, Gondia, Nagpur, Wardha.

[16] Gokhale Institute of Politics and Economics is the Agro-Economic Center for Maharashtra.

Table 4.4: Irrigation in Vidharbha (2001–2002)

Division	Area under Surface Irrigation (in 1000 Ha)	Area under Groundwater Irrigation (in 1000 Ha)	Total Area under Irrigation (In 1000 Ha)
Years	2001-02	2001-02	2001-02
Konkan (Coastal)	25.43	27.40	52.83
Percent of Total Area	2.42	1.43	1.78
Nashik (Coastal)	108.13	302.43	410.56
Percent of Total Area	10.30	15.78	13.84
Pune (Western)	246.23	476.20	722.43
Percent of Total Area	23.45	24.85	24.36
Kolhapur (Western)	158.33	249.50	407.83
Percent of Total Area	15.08	13.02	13.75
Aurangabad	139.77	310.17	449.94
Percent of Total Area	13.31	16.19	15.17
Latur	89.30	184.47	273.77
Percent of Total Area	8.50	9.63	9.23
Amravati(Vidharbha)	47.73	129.90	177.63
Percent of Total Area	4.55	6.78	5.99
Nagpur (Vidharbha)	235.17	235.93	471.10
Percent of Total Area	22.40	12.31	15.88
Maharashtra	1050.09	1916.00	2966.09

Source: Planning Commission (2007)

This semi-arid geology makes the search for groundwater in Vidharbha region very challenging and the development of irrigation facilities difficult (Subramanium 1975). Unlike the regions of the alluvial plains, where there is greater likelihood of striking groundwater through wells, in the semi-arid region of the Deccan where Vidharbha lies, there is greater uncertainity of finding groundwater. Historically, government sponsored well digging programs have been wasteful given the hard terrain of Vidharbha (Gokhale Institute of Politics and Economics 1983). Farmers who

lack geological knowledge face similar problems. For instance, a guard working at the Young Women's Christian Association (YWCA) hostel of Nagpur (a district in Vidharbha), who grew cotton for two years before giving it up notes: "I dug a well to water my cotton field but no water appeared even after second year of digging. I lost all my investments in my cotton field and had to give up farming."[17]

Severe soil erosion prevails in Vidharbha (Gokhale Institute of Politics and Economics 1983).[18] Because of decades of unchecked erosion, the productive capacity of soil has progressively deteriorated (Planning Commission 2006), affecting water retention and percolation (Gokhale Institute of Politics and Economics 1983). "Once the water table is depleted in groundwater acquifers in semi-arid areas such as Vidharbha it cannot be easily recharged."[19] Besides poor soil quality, the Vidharbha region suffers from naturally occurring chemical contamination from nitrates and salts (Gokhale Institute of Politics and Economics 1983).

Surface Water: The hard rock and undulating terrain of Vidharbha impedes the development of surface water irrigation there (Planning Commission 2006), leading to small flow in rivers (Gokhale Institute of Politics and Economics 1983). Also increased is the cost of irrigation development (Planning Commission 2006).

While the current percent area under irrigation in Vidharbha is 21.87% (15.88% in the Nagpur division+5.99% in the Amravati division), the total irrigation potential (the percent area that can be potentially irrigated) for the Vidharbha region is around 31.60% (Planning Commission 2006). Thus, there is still a possibility of

[17] Interview with Chowkidar Atmaram, YWCA Hostel, Nagpur, July, 2006.

[18] Comment, Jaywandhia, July 3, 2006 at CSE-NCF Roundtable Workshop, Delhi, 2006.

[19] Interview, Vasant Sabherwal, Program Officer, Ford Foundation. New Delhi, June, 2006.

developing further irrigation, despite geological constraints, even though 100% irrigation development is still not possible.

Status of Irrigation Projects: The level of irrigation development in Vidharbha is low not only because of geological constraints (semi arid terrain) but also because of the presence of irrigation projects that have been planned and sanctioned but not operationalised. According to the Planning Commission Report on Farmers Suicides (2006), the Forest Act of 1970 prohibits the cutting of trees, and this has led to the stalling of around 101 surface irrigation projects. Moreover, the Irrigation Department of Nagpur claims that the presence of environmentalists such as Medha Patkar, a prominent social activist, is also a stalling influence on the building of surface irrigation projects.[20] Further, the overall development of the irrigation sector in Vidharbha is also affected by an irrigation backlog.[21] In the case of Vidharbha, according to the Planning Commission Report on Farmers Suicides, the irrigation backlog in Vidharbha increased from 38.05% in 1982 to 62.20% between 1982 and 2002, while the irrigation backlog in the rest of Maharashtra declined from 39% to 4.73% in the same years (Planning Commission 2006, 73).

Water Rates: A final reason that cotton fields stand unirrigated is the "rationality" of the poor farmer. Vilas Doipude, Public Relations Officer, Vidharbha Department of Irrigation, explains that farmers do not apply water to the fields even when water is available, which is a function of the low economic capacity of farmers and the high cost of water. As Table 4.4 shows, 4.55% of the irrigation water available in Amravati Division and 22.40% of water available in Nagpur division was surface

[20] Interview, Irrigation Officials, Irrigation Department, Nagpur, Maharashtra, July, 2006.

[21] The term 'development backlog' is used in India to denote the disparity between a region's legitimate share of development funds and the actual receipt and use of funds in the region. In a democracy, public funds are expected to be equally distributed among various regions for balanced growth in the state. When there is unequal allocation or use of funds, there is a development backlog. See: Vidharbha Development Backlog. Accessed at: http://www.empowerpoor.org/backgrounder.asp?report=357

irrigation water in 2001–2002. While statistics are not available regarding how much water development falls under canals, the surface water available in the canals is governed by the Maharashtra Water Regulatory Act. Water rates in Maharashtra (and consequently Vidharbha) amounted to 4.00–9.02[22] USD per hectare in 2003. These rates are much higher compared to other Indian states, and they have been increased six times since the 1980s (Narayanmoorthy 2007). Local political factors also affect how water schemes function. According to a Nagpur irrigation official, "While we are able to obtain the dues from the small farmers, it is very difficult to obtain dues from the large landlords."[23]

Pests: While farmers have battled with water scarcity in Vidharbha since historical times, a new problem that they have been facing since the past decade is the high incidence of pest attacks. According to the government run Tata Institute of Social Sciences (2006) report on farmer suicides in Vidharbha: "In the cotton belt, the crop seems to have failed more than once in the last four years. This crop failure has always not been associated with natural calamities, such as failure of rain or un-seasonal rains leading to destruction of crops. The causes are an increase in pest attacks in the last few years, especially from 1995 onwards" (TISS 2006).[24]

The Green Revolution came to cotton farming in Vidharbha through new cotton hybrids developed in 1972. The first hybrid, H4, was developed at Gujarat Agricultural University, a cross between the desi (indigenous) cotton variety and an American hybrid cotton (CSE-NCF Roundtable Briefing Paper 2006). The

[22] Rs. 180= Rs. 180/45=4 USD and Rs 406= Rs 406/45=9.02 USD.

[23] Interview, Doipude, Public Relations Officer, Nagpur Irrigation Department, Nagpur, Maharashtra, 2006.

[24] The Tata Institute of Social Sciences Report was prepared after a public interest litigation was filed in the Mumbai court regarding farmer suicides. The Tata Institute of Social Sciences is a government run institute.

development of new cotton hybrids was also undertaken by the private sector.[25] Government institutes such as Central Institute of Cotton Research (CICR), Nagpur[26] developed a number of hybrids and open (non hybrids or straightline) varieties to deal with various pests and suitable to different cotton agro-economic zones over the years. Private hybrids have gained much popularity recently. Table 4.5 shows the coverage of hybrids in cotton areas in the two districts in Vidharbha where suicides are concentrated.

Table 4.5: Area under Cotton Hybrids in Two Important Vidharbha Districts

	Year	Percent of Area Under Hybrid Cotton To Area Under Total Cotton
Yavatmal	1999–00	85.00
	2000–01	75.00
	2001–02	93.00
Wardha	1999–00	74.00
	2000–01	78.00
	2001–02	77.00

Source: IGIDR (2006)[27]

As Table 4.5 shows, the area covered by cotton hybrids increased overall from 85% to 93% and from 74% to 77% of the total area under cotton in both districts from 1999–2004. Time series data on productivity are not available, but farm activist Vijai Jaywandhia of the Shetkari Sangathana[28] notes that "the new hybrids did increase cotton productivity and farmers profits during the period of 1970–1980 when the

[25] Interview, Vijai Jaywandhia, Shetkari Sangathana, Wardha, Nagpur, July, 2006.

[26] This is a central government institute located in Nagpur, Maharashtra and comes under the Government of India's National Agricultural Research Systems.

[27] Figures calculated by Indira Gandhi Institute of Development Research.

[28] Shetkari Sangathana is one of the biggest social movements in Maharashtra, which started in the 1980s on setting the right price of onions.

cotton prices were good."[29] From 1971–72, the Indian government had launched the Intensive Cotton District Programme to meet the challenge of raising cotton productivity in the country. Cotton prices increased sharply in 1973–74 and hit an all time high in 1976 (Peshin, Dhawan, Vatta, Singh 2007).

Although data are not available that allows us to draw a correlation between use of hybrids and increasing pest populations, the indiscriminate use of synthetic pesticides that accompanied hybrids did lead to the pests' developing resistance. The American Bollworm, a polyphagus pest (*H. Armigera*), has emerged as a major pest not only in Vidharbha but also other cotton regions (ICAR 2007).[30] In Vidharbha and other cotton areas in Maharashtra, cotton can be damaged by more than 20 other cotton pests (Central Institute of Cotton Research 2006). Data from the Central Institute of Cotton Research (CICR), Nagpur (Government of India 2006) show that at the seedling stage, sucking pests (*Amrasca biguttulla*), Aphids (*Aphis gossypii*) and Thrips (*Thrips tabaci*) cause serious damage to cotton crops.

From 1985–86, the on-white fly (*Bemica tabaci*) has become a significant sucking pest. The spotted bollworm (*Earias insulana and Earias fabea*), the American Bollworm (*Helicoverpa armigera*) and the Pink bollworm (*Pectinophora gossypiella*) have been found to cause heavy losses in cotton crops. Incidence of leaf defoliators, the tobacco leaf eating caterpillar (*Spodoptera litura*) and the cotton leaf roller (*Sylepta derogata*) occur very rarely. In the past 10 years, incidences of the leaf miner (*Bacculatrx thuribiella*) have also been noticed (CICR 2006).[31] As a result, the amount of pesticides that are being sprayed in the case of cotton in Vidharbha is extremely

[29] Interview, Vijai Jaywandhia, Shetkari Sangathana, Wardha, Maharashtra, July, 2006.

[30] Interview, Vijai Jaywandhia, Shetkari Sangathana, Wardha, Maharashtra, July, 2006.

[31] CICR (date not available). Approved Package of Practices in Maharashtra State. Accessed at: http://www.cicr.nic.in/pop/mh.pdf

high: The per hectare usage is nearly 13 times higher than that for soybeans; 82 times higher than that for tur and 442 times higher than that for sugarcane (Planning Commission 2006).[32] Different varieties of pesticides over the years have not been able to control the bollworm population and have instead led to negative effects on the natural enemies of the cotton pests.[33]

Pesticide Selection and Effects of Pesticides: Farmers use a combination of expensive chemical pesticides to control pest infestation in Vidharbha. Because cotton is prone to attack from insects throughout the growing season, farmers have to spray insecticides continuously (IGIDR 2006). They are not very choosy in terms of their pesticide selection. "Farmers use any pesticide that is available to them in the market. Currently it is Endosulphan."[34] Most of these pesticides are sprayed with hand sprayers or motorized back-pack sprayers. The quality and maintenance of these sprayers are very poor, resulting in inadequate delivery rates of pesticides (Kranthi et al. 2002). As entomologist Keshav Kranthi, CICR, puts it: "Even while a new chemistry of pesticides has been released in the past 6–7 years which needs to be sprayed in less quantity, the conventional pesticides based on the old chemistry continue to be popular." The reason why conventional pesticides are still accepted, according to Sainath (2006), editor, Rural Affairs, *The Hindu,* is the lack of an adequate agricultural extension network in Vidharbha. In the absence of government provided extension services, farmers rely on the private sector seed agents. According to one farmer, Shyam Wagadhe, a former member of the Shetkari Sangathana,

[32] Bt toxin and Bt in other forms hold some potential for its destruction (Chandrasekhar, Kumari, Kalia and Gujar 2005).

[33] According to Keshav Kranthi, entomologist, CICR, "The pyretheroids popular during the 1980s were kill all sprays. Repeated and excessive spraying of pesticides has led to the decline of the natural enemies."

[34] Interview, Shyam Waghade, Farmer, Wardha, Maharashtra, July, 2006.

"Farmers trust the seed agents."[35]However, seed agents lack information on proper formulations, selections or pesticide applications (IGIDR 2006).

So much of the pesticide sprayed is both of poor quality and inadequate formulations. "There is an abundance of spurious pesticides in the market in Vidharbha."[36] Thus, in the absence of adequate information either from the private sector or the public sector, farmers resort to indiscriminate spraying of pesticides in the region, even with poor returns from the spraying of pesticides. "Farmers spray pesticides in competition with each other in Vidharbha." [37] According to Keshav Kranthi, entomologist, CICR (Nagpur, Vidharbha), "Some of the pesticides are tank mixes (non-branded pesticides) which are not of much use and are sprayed again and again." Table 4.6 shows distribution of chemical fertilizers by number of public and private institutions between the years 1998-2003.

Table 4.6: Distribution of Chemical Fertilizer by Institutions

Year	Public Regulated Institutions (Percent of Total)	Private Institutions (Percent of Total)
1998–99	32.50	67.50
1999–2000	31.30	68.70
2001–02	27.45	72.50
2002–03	27.62	72.38

Source: IGIDR (2006)

Private sector operators are poorly regulated by the government. Although the bigger and popular pesticide agencies would be providing quality pesticides, the

[35] Interview, Shyam Wagadhe, Farmer, Wardha, Maharashtra, 2006.

[36] Interview, Pankaj Shiras, JK Seeds, Nagpur, Vidharbha, July, 2006.

[37] Interview, Pramod Mahajan, Organic Farmer, Wardha, Maharashtra, 2006, Interview, Shyam Wagadhe, Farmer, Wardha, Maharashtra, 2006.

presence of small enterprises that are unregulated and unable to be regulated can lead to the presence of affordable but spurious pesticides on the local market. Indiscriminate pesticide use has also affected the farmers' health in Vidharbha. Public health studies in Vidharbha show that pesticide spraying has affected low income farmers and agricultural laborers the most (IGIDR 2006).

Overuse of pesticides has also affected the soil: "Earlier the soil in this area could give cotton production of 1 metric tonne per hectare, but now it only gives a production of 0.5–0.6 metric tonnes per hectare."[38]

Quality of Hybrid Seeds: Another big reason for the low and fluctuating productivity of cotton is the decline in the quality of cotton hybrid seeds over a period of time (IGIDR 2006). Farm activist Vijai Jaywandhia claims that the decline in quality of hybrid seeds is due to the increasing involvement of the private sector in their production.[39] Private-sector cotton hybrids need not undergo a rigorous process of certification as public sector varieties do, which can lead to spurious quality.[40] Poor production quality is common.[41] A similar claim is made by sociologist Hemachandra Gajbhiye at CICR: "Quality of hybrid seeds is poor as these are driven by market forces."[42]

Hybrid and straightline (non hybrid) varieties are available through the Maharashtra's Agricultural State Department. However, the state's approach to

[38] Interview, Atul Shiras, JK seeds, Nagpur, Maharashtra, July 2006. Here Quintals has been converted to Metric Tonnes. 1 Quintal=0.1 Metric Tonne.

[39] Government certified seeds go through a rigorous process of certification for their purity by the Central Varietal Release Committee established under the auspices of the National Agricultural Research Systems (NARS), housed at Pusa Institute in Delhi.

[40] Interview, Vijay Jaywandhia, Shetkari Sangathana, Wardha, Vidharbha, July, 2006.

[41] Interview, Raj Gupta, International Maize and Wheat Improvement Institute, Delhi, 2006. The Central Varietal Release Committee is a special committee which certifies seeds for purity.

[42]Interview, Hemachandra Gajbhiye, Sociologist, CICR, July, 2006.

promoting seeds has been a "lab to land approach" where the farmer has to pay immediate money. In contrast, the private sector engages in aggressive marketing and lends money to farmers. The private sector seed agencies also give commissions to agents to sell seeds, which lead to greater sales of private sector hybrid seeds.[43] Small private operators who do not produce good quality seeds may sell them at a rate that is cheaper than good quality government or private sector hybrids.

Cotton Marketing and the Maharashtra Cotton Monopoly Procurement Scheme: Cotton procurement in India is regulated by the Cotton Corporation of India (CCI), a body created in 1970s to stabilize prices, regulate imports and supply raw material to public sector textile mills (Gulati, Bhide, Bhagat and Shroff 1996). However, CCI buys 30% of all cotton in India, and the rest of the procurement and trading is done through the private sector or cooperatives (Gulati, Bhide, Bhagat and Shroff 1996), except for the case of Maharashtra.

Cotton marketing in Maharashtra, unlike other Indian states, since 1971, has been regulated through the Maharashtra Monopoly Raw Cotton Procurement, Processing and Marketing Act. This Act prohibited all private trading in cotton, and cotton farmers had to sell their goods to an agency called Maharashtra State Co-operative Cotton Growers Marketing Federation. The main objective of the scheme was to ensure a fair and remunerative price to the cotton producers, to make additional income transfers to the cotton growers by eliminating middlemen, to bring stability in the incomes of growers as well as to bring stability and growth in the overall production of cotton in the state (there was a Price Fluctuation Fund built in the scheme) and to supply scientifically graded quality cotton to the consumer mills (IGIDR 2006). The hallmark of the scheme was to give a guaranteed price to the

[43] Interview, Hemachandra Gajbhiye, Sociologist, CICR, July 2006.

grower that would remain the same throughout the season, even if the Federation would not sell at that price (IGIDR 2006). Farmers would also receive a bonus if the Monopoly Cotton Procurement Scheme made profits (Planning Commission 2006). Textile mills bought cotton directly from the Federation.However, after fifteen years, the scheme started to become dysfunctional.[44]

In 1993–1994, competitive prices in the border markets of adjoining states were substantially higher than the Maharashtra guaranteed price (IGIDR 2006). If the border prices were higher than the state price, the government paid the farmers an additional advance price (so that the farmers sell it to the Maharashtra government and not in other states where price is higher). Paying unduly high guaranteed prices may have stopped outflow of cotton to border states, but these prices could not be recovered at the time of sales (IGIDR 2006). Furthermore, farmers from neighboring states started selling their cotton in Maharashtra.[45] The financial problems of the scheme were further accentuated because the Federation was slow in marketing its full pressed bales. Prior to the commencement of the 2001–2002 cotton marketing season, the Federation had cotton bale stocks worth 493 million USD[46] (Shroff 2006). The Federation would take almost 23 months to dispose of the stocks. In comparison, the speed at which the private sector finalizes deals and changes prices cannot be matched by the Federation because of its bureaucratic setup. Private traders dispose of their stocks within a period of 3 to 4 months. Holding cotton stocks for long periods affected the interest rate the Federation owed to the co-operative banks first and the low price at which the Federation had to sell its cotton second. These time deficits led to the Federation incurring huge interest charges from co-operative banks and other

[44] Interview, Vijai Jaywandhia, Shetkari Sangathana, July, 2006.

[45] Interview, R.B. Singh, National Commission of Farmers, Delhi, July, 2006.

[46] Rs. 2,220crore= Rs 22,200,000,000/45= 493,333,333 USD.

financial lending institutions (Shroff 2006). Also, holding cotton stocks for as long as 23 months led to deterioration in the quality of the cotton. Sometimes, the Federation had to offer discounts on its sale operations, and this, in turn, led to greater losses (IGIDR 2006).

Corruption in the Scheme: The scheme also suffered from growing corruption due to the lack of farmer participation in decision-making. Sunil Talatule, President of Nagpur Ginning Association, argued, "Unlike the case of Gujarat, where the farmers were in direct contact with the mills, the monopoly scheme was managed by politicians. Farmers are not free to decide the membership of who manages the scheme."[47]

Farmers have to travel long distances and face week-long waits in open areas to get their cotton graded (IGIDR 2006). Given that many of the small and marginal farmers are already indebted to the input dealers and traders, the farmers tend to sell their product to these dealers at a price lower than the MSP. The traders then sell the cotton to the government at the MSP (IGIDR 2006). Their cotton was improperly graded and farmers were not given the remuneration that was reserved for the particular cotton grade that they were selling. For instance, "If the price of cotton A is 42 USD[48] and cotton B is 38 USD,[49] the grader might grade cotton A as cotton B giving the farmer a lower price for their cotton."[50] Often cotton from other cotton growing states was sold in Maharashtra to obtain the better price while cotton from Maharashtra was sold in other states.[51]

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[47] Interview, Sunil Talatule, Ginner, Nagpur, Wardha, November, 2006.

[48] Rs 1,900= Rs, 1,900/45=42.22 USD

[49] Rs 1,700= Rs. 1,700/45=37.77 USD

[50] Interview, Sunil Talatule, Ginner, Nagpur, Wardha, November, 2006.

[51] Interview, R.B. Singh, National Commission of Farmers, November, 2006.

Growing corruption led to not only lower prices for farmers but also to scheme losses (Shroff 2006). Because of financial mismanagement, the Monopoly Procurement Scheme was discontinued in 2005, and the cotton market was opened to private procurement.[52] Besides selling in the open market, farmers can now enter into contract arrangements between the private traders and ginning mill owners.[53] However, individual farmers do not have much bargaining power vis-à-vis the traders or ginners, who have associations of their own. Cooperatives or marketing societies for cotton do not exist in Vidharbha.[54] One possible reason for the lack of their emergence is the existence of the Monopoly Procurement Scheme itself. The scheme provided farmers with assured prices, but left control of the cotton prices and management in the hands of the government, which has made farmers very dependent on this authority.

The Maharashtra government did not encourage the development of cooperative institutions for Maharashtra's cotton farmers. The experiences of both Gujarat and Western Maharashtra show the important role that the government played in encouraging cooperatives. For instance, in contrast with the case of cotton farmers, the sugarcane cooperatives were powerful enough to help their members build linkages with appropriate research institutions, industries and government.[55] Sugarcane farmers have not only been able to access inputs such as irrigation and good quality seeds, but also to obtain better prices.[56] The cotton farmers lack this kind of bargaining power.

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[52] Interview, Sandeep, Reporter, Lokmat, Interview, July, 2006.

[53] Interview, Sunil Talatule, Interview, 2006, Sandeep, Interview, 2006.

[54] Interview, Vijai Jaywandhia, Shetkari Sangathana, Wardha, Nagpur, July, 2006.

[55] Interview, Vijai Jaywandhia, Shetkari Sangathana, Wardha, Nagpur, 2006.

[56] Interview, Jaideep Hardikar, DNA, Nagpur, Maharashtra, 2006.

As the market opens up to private trade, local textile mills such as Mohota Textile Mills have initiated contract farming arrangements in three districts in this region. This contract farming arrangement provides technical advice to farmers, but does not include procurement of cotton from farmers like many other contract farming arrangements.[57] According to Mohota Textile Mills, "We want the farmers to gain experience in the market. That is why we don't buy the cotton from them." The end of the Maharashtra Cotton Monopoly Procurement Scheme had led to greater distress for farmers in 2006. The Planning Commission Report(2006) on Farmer Suicides states that "the immediate trigger of present distress was the sudden shock faced by the farmers due to the withdrawal of monopoly procurement which had been in vogue for the past over two decades."

Indebtedness: The lack of rural credit and productive capital has been a constraining factor in many rural economies. Explaining the factors that are leading to farmers' distress in Vidharbha, Shetkari Sangathana member, Vijai Jaywandhia, states, "Rainfed dryland regions, such as Vidharbha, have not had as extensive a coverage of rural credit and banking operations as the irrigated areas of the Green Revolution."[58]

What is the status of credit operations in Vidharbha? Statistics are available at the level of Maharashtra that are applicable to Vidharbha as well. According to the IGIDR (2006) Report on Farmer Suicides, in comparision to other states, the level of overdues[59] and outstanding loans in Maharashtra's rural financial institutions are the highest, more than 30% in the state in 1997.

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[57] Interview, Mohota, Mohota Textile Mills, Hinganghat, Maharashtra, July, 2006.

[58] Interview, Vijai Jaywandhia, Shetkari Sangathana, Wardha, Nagpur, July 2006.

59 Poor recovery of loans results in overdues. Overdues are defined as loans and interest thereon not repaid on due dates. The financial health of banking business heavily depends on recovery of loans. Of the total amount of loan due at different points of time, some of it is recoverable and some irrecoverable and the latter often turns into bad debt or defaults. See IGIDR (2006).

Cooperative Banks operating in Maharashtra showed the highest amount of non- performing assets (NPA) among various states.[60] The share of Maharashtra in total NPAs of State Cooperative Banks (SCBs) at an all-India level was estimated at 31.76 % in 2002 and increased to 43.16 % in 2004 (IGIDR 2006). The percentage of NPAs to loans outstanding of SCBs in Maharashtra was also higher than the national average. This percentage, in the case of Maharashtra, was 16.09% and 32.41% in the years 2002 and 2004. In the same years, the national percentage of NPAs to loans outstanding was 13.52% and 18.30%. In terms of Scheduled Commercial Banks, between 1996 and 2004, there was decline in total number of Scheduled Commercial Bank branches from 2320 to 2241 in Maharashtra. This signified a decline in percentage terms of total bank branches from 49.30 to 45.7% between 1996 to 2004 (see Table 4.7). Further, agricultural credit as a percent share of total credit declined from 16% to 10.7% (Mishra 2006).

Table 4.7: Rural Credit in Maharashtra, Scheduled Commercial Banks

Indicator	Year	Maharashtra (Apart from Mumbai)
Rural Branches as Percent of Total Bank Branches	1996–97	49.30
	2004	45.70
Agricultural Credit as Percent of Total Credit	1996–97	16.00
	2004	10.70

Source: Mishra (2006)[61]

The rural credit-deposit ratio (C-D ratio) of Scheduled Commercial Banks in Maharashtra showed a decrease between 1991 and 1999. The C-D ratio at the level of

[60] Non performing assets are those loan advances that are marked with non-payment of interest or repayment of principal or both for a period of two quarters or more during the year ending. An amount is considered to be post-due if its unpaid for 30 days beyond due date.

[61] This data has been calculated by Mishra (2006).

Maharashtra increased from 71.91% to 74.18% from 1982 to 1993, then decreased to 65.02% in 1999 (IGIDR 2006). Although this continued to be higher than the prescribed limit of 60%, in 1999, when Mumbai is separated from the analysis, this fell to 59% in 1999. Further distribution of the C-D ratio across districts highlights that the majority of Vidharbha districts showed a C-D ratio of less than 60% in 1999. The C-D ratio falling below 60% signifies that the commercial banks in Vidharbha were marked with poor performance as their loans fell to less than 60% of their deposits, affecting the rural credit delivery adversely.

In terms of credit cooperatives, another mode of formal credit, there was slower growth in the number of credit cooperatives between 1990 and 1999 than between 1982 and 1990 for all Maharashtra. The rate of growth in the outstanding loans of these cooperatives was higher than the rate of growth in loan advances between 1982 and 1999 for overall Maharashtra (see Table 4.8).

Table 4.8: Cooperative Bank Finances in Maharashtra

Year	Numbers of Coop Banks	% Increase	Loan Advances (in Million USD)	% Change	Outstanding Loans (in Million USD)	% Change
1982	18,596		36,060		19,380	
1990	19,694	5.90	102,270	64.74	63,320	69.39
1999	20,378	3.47	244,750	139.32	187,300	195.80

Source: IGIDR 2006

After the 1990s, there has been a slowing down of borrowing per member from credit cooperatives in the case of cotton crops vis-à-vis other field crops (IGIDR 2006). While it would be difficult to say that there is a failure of the rural credit system in Maharashtra (and Vidharbha), the above-mentioned statistics indicate its poor performance or the slowing down of instutional credit availability for farmers.

In the absence of formal credit, moneylenders become more accessible ready credit providers (IGIDR 2006) for both agricultural production and consumption purposes. Moneylenders who have migrated from nearby Gujarat have been operating in Vidharbha for 15–16 years.[62] Many of them are also seed agents and input dealers: "The unauthorized moneylenders keep a higher margin for getting the credit back and give low quality inputs such as seeds and pesticides."[63] However, despite these drawbacks, and the fact that the interest rates charged by moneylenders are as high as 120% per year (Sainath 2005),[64] the moneylender is not considered an evil figure by the farmers.[65]

While exact data are not available as to what kind of farmers (large versus small) have access to formal banking institutions, the high interest rates on loans from the formal banking sector (14%) and stringent conditions possibly leave small and marginal farmers out of the formal credit system (Planning Commission 2006).[66] According to Mohanty (2005), who studied farmer suicides in Vidharbha, while large farmers have access to institutional sources of credit, it is the small and marginal farmers that are mostly dependent on the non-institutional sources of credit. These small farmers mortgage their land or jewelry as collateral for obtaining loans from informal sources and loss of the collateral was a major reason for farmer suicides.

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[62] Interview, Vivek Deshpande, Journalist, Indian Express, Nagpur, Maharashtra July, 2006.

[63] Interview, Pankaj Shiras, Seed Dealer, Nagpur, Vidharbha, Maharashtra, 2006.

[64] A similar rural interest rate between 50-100% is quoted by author N C Saxena in terms of rate of interest charged by moneylenders. For instance, see http://www.cseindia.org/programme/nrml/Budget_specials_march08.htm

[65] Interview, Naveen, Editor, Navrashtra, Nagpur, Maharashtra, 2006.

[66] This has been a problem since the Green Revolution, as Herring (1985) notes regarding the policy bias in government credit operations that left many small farmers devoid of institutional credit. In the case of dryland farmers, these credit rates have only recently come down to 6% after the implementation of the Prime Minister Relief package for Vidharbha in 2006 (Planning Commission: 2007).

Many farmers in Vidharbha and Maharashtra are indebted. According to Table 4.10, 54.48% of farmers in Maharashtra were indebted in 2003. Studies relating to farmer suicides in Vidharbha show that indebtedness is one of the major factors leading to the farm crisis (IGIDR 2006, TISS 2006). Farmers have committed suicide even when their debts have been as low as 178 USD[67] (TISS 2006). These debts could be from either institutional or non-institutional sources.

Despite this scenario, ad hoc measures such as a recent government crackdown on moneylenders in Vidharbha misfired because farmers had nowhere to raise credit in the absence of an expansion of institutional credit mechanisms.[68]

Crop Insurance: Crop insurance could be an important safety net for the farmers. Crop insurance, however, has only been available for select crops in India. The National Agricultural Insurance Scheme (NAIS) only covers 4% of the agricultural sector operations (Planning Commission 2007). Earlier, loans and insurances were linked together, but were too expensive for small farmers to buy. The insurance premium for agriculture is 16%.[69] Thus, many farmers who were unable to obtain loans do not get insurance either. The way insurance was evaluated was problematic:

> The patwari or the village land records holder does not evaluate the crop yields properly when fields get destroyed. A cotton field produces 6 quintals of cotton per 1 acre. The insurance limit is set for 1 quintal in case of crop damage. But the patwari will give insurance only if the yield is 0.9 quintals per acre and not give insurance if the yield is 1.1 quintals per acre.[70] Compensation for the loss is based on average productivity of the area. This very often means that the actual loss suffered by the farmers is far higher than the average loss.

[67] Rs 8,000=Rs. 8,000/45=177.77 USD.

[68] Interview, Vivek Deshpande, Reporter, Indian Express, Interview, 2006.

[69] Field Report, National Commission of Farmers, chaired by M.S. Swaminathan, Filed by R.V. Bhavani.

[70] Interview, Sandeep, Reporter, Lokmat, Vidharbha, Maharashtra, July, 2006.

> The scheme does not include coverage for the loss of income by the farmer. (Express News Service 1999)

Diversification to Non-Farm Work Opportunities: Even though farmers in Vidharbha grow jowar and soyabean, cotton production forms their primary source of income (IGIDR 2006).[71] According to the Planning Commission Report on Farmer Suicides (2006), there is a lack of diversification to non-farm activities in Vidharbha. Diversification to both farm and non-farm activities requires monetary and institutional support. However, according to the Planning Commission Report (2006), Vidharbha faces a huge "development backlog"[72] in terms of region-wise allocations.

A Government of Maharashtra appointed Fact Finding Dandekar Committee evaluated the development backlog in a number of sectors such as land development, roads, irrigation, village electrification, general electrification, technical education, health services and water supply. In 1984, this backlog amounted to 277 million USD,[73] making Vidharbha one of the most economically deprived and infrastructurally underdeveloped regions in Maharashtra (Planning Commission 2006). While a Vidharbha District Development Board was formed in 1984 to address the development imbalance, and budgetary allocations were made to between the amounts of 44 million -111 million USD[74], this problem could not be addressed (Planning Commission 2006). Demands have been made for a separate Vidharbha state, to address the low levels of development in this region.[75] Thus, diversification to

[71] Cotton is grown by 4 million cultivators, India-wide.

[72] The term 'development backlog' is used in India to denote the disparity between a region's legitimate share of development funds and the actual receipt and use of funds in the region. In a democracy, public funds are expected to be equally distributed among various regions for balanced growth in the state. When there is unequal allocation or use of funds, there is a development backlog. See: Vidharbha Development Backlog. Accessed at: http://www.empowerpoor.org/backgrounder.asp?report=357

[73] Rs 1,246.54 crores= Rs.12,465,400,000/45= 277,008,888 USD=277 million USD.

[74] Rs 200 crore=Rs.2,000,000,000/45=44,444,444 USD=44 million USD and Rs. 500 crore= Rs. 5,000,000,000/45= 111,111,111 USD=111 million USD.

[75] Interview, Rambadwar, Vidharbha Development Board, Nagpur, July, 2006.

other crops or non-farm activities that requires financial and institutional support is not forthcoming in the case of Vidharbha.

As later sections will show, the fact that farmers are heavily indebted makes taking further loans inaccessible, another reason why farmers are unable to undertake diversification on their own. Income diversification could also occur through non-farm employment. Opportunities in non-farm employment have been declining and are shrinking in the off-farming seasons (TISS 2005). A different set of skills is needed to diversify to other crops. Cotton had been grown in Vidharbha even before the colonial period (1897–1947). In this period, cotton from Berar (modern day Vidharbha) was exported to cotton mills in Great Britain. These exports increased during the period of the American Civil War and famine in Lancashire (cited in Mohanty 2005). The pressure for cotton farming during the colonial period, and the emphasis on cash crop cultivation made cotton farming an important skill for the people in this region. This prevalence of cotton farming further attracted those migrants who were unsuccessful in finding and maintaining jobs in the city. Field evaluations of farmers committing suicide by the government run IGIDR in Mumbai (2006), show that a large proportion of those committing suicides are younger farmers who have relatively low experience in farming but who have been educated and could not find suitable employment. Others such as those belonging to low castes also continued to engage in cotton farming, even though they did not have the skills to farm cotton, but they have received extra land holdings from the government in the form of wastelands or surplus properties through the implementation of land ceilings (Mohanty 2005). Agriculture was in a state of crisis in Vidharbha when GM seeds were introduced in the area in 2002. An old time seed agent of the area, Pankaj Shiras, of JK seeds[76] notes that "the

[76] Interview, Pankaj Shiras, JK Seeds, Nagpur, Maharashtra, July, 2006.

rural economy in Vidharbha has collapsed." Vishal Rawat, who belongs to an agricultural family in Vidharbha notes: "The only option for the agricultural economy of Vidharbha is to bail out the people from farming."[77]

Economic Unviability of Farming in Rainfed India

While the above sections detail the specific situation in Vidharbha, the situation in many regions of India is quite similar, especially rainfed areas. A number of governmental and non-governmental evaluations from various states have pointed out this crisis. For instance, the Commission of Farmers Welfare set up for the central-western state of Andhra Pradesh in 1998 noted,

> Farming is in an advanced stage of crisis. The problems of farming are evident, ranging from frequent droughts and soil degeneration, to lack of institutional credit and insurance leading to excessive reliance on moneylenders, non-availability of reliable and reasonably prices inputs to problems of marketing and high volatility of crop prices. But crisis is also reflected in other features of the rural economy: the decline in agricultural employment and stagnation of employment, leading to reduced food consumption and forced migration of workers and forced migration of workers. Drought affected areas in Telangana and Rayalseema bear the brunt of the burden, even though irrigated farmers are also affected. (Ghosh et al. 1998)

One government report has even gone to the extent of declaring an agrarian crisis for the whole of India. The 2007 Report of the Expert Group on Farmers Indebtedness, written by economist R. Radhakrishna for the Ministry of Finance notes: "Indian agriculture is passing through a period of severe crisis. Although some features of the crisis started manifesting themselves in 1980s, the crisis assumed serious dimensions in the middle of the 1990s" (Ministry of Finance 2007). Similarly, the 2005 National Commission of Farmers[78] report titled "Serving Farmers: Saving Farming" notes,

[77] Interview, Vishal Rawat, Editor, Agricultural Newspaper, Previous Resident of Vidharbha, Delhi, April, 2006.

[78] This Commission was established under the Ministry of Agriculture in 2005 after news of the agrarian crisis spread in the media.

"The acute agricultural distress now witnessed in the country, occasionally taking the form of suicides by farmers, is the symptom of a deep-seated malady arising from inadequate public investment and insufficient public action in recent years." Commenting on the nature of the farm crisis, Professor R. B. Singh, member of this commission, and previous Additional Director General of FAO commented that "we need to raise farmer's income. No government can afford to ignore the needs of the agricultural community."[79]

Agriculture's contribution to the Gross Domestic Product (GDP) has declined from 56% in 1950–51 to 23 % in 2005–06, whereas 58% of the total workforce and 73% of the rural workers are still dependent on agriculture. Table 4.9 highlights the farm sizes and their expenditures and incomes across India in 2003. According to Table 4.9, in the farm sizes between 0.01–4.00 hectares (small and marginal farmers), the average monthly expenditure of farming communities is much below their average monthly income. For instance, in the case of farm sizes less than 0.01 hectare, the average monthly income is 30.67 USD while monthly expenditure is 51.04 USD. In the case of farm sizes greater than 10 hectares, the average monthly income is 214.82 USD and average monthly expenditure is 142.62. Table 4.10 shows the levels of indebtedness across all farm sizes in India in 2003. According to Table 4.10, there are high rates of indebtedness across all farm sizes. Table 4.11 shows the rates of indebtedness across Indian states. As Table 4.11 indicates, the highest rates of indebtedness are found in the states of Punjab, Andhra Pradesh, Tamil Nadu, Kerela, Karnataka and Maharashtra.

[79] Interview, R.B. Singh, Member, National Commission of Farmers, July, 2007.

Table 4.9: Income and Expenditure across Farm Sizes in India (2003)

Farm Size class (hectare)	Average Monthly Income (USD)	Average Monthly Expenditure (USD)	Difference between Expenditure and Income (USD)
Less than 0.01	30.67	51.04	-20.38
0.01–0.40	36.29	53.11	-16.82
0.41–1.00	40.20	59.38	-19.18
1.00–2.00	55.40	69.96	-14.56
2.00–4.00	78.87	81.89	-3.02
4.00–10.00	126.24	102.80	23.44
Greater than 10.00	214.82	142.62	72.20

Source: National Sample Survey Report 497 (2005a)

Table 4.10: Levels of Indebtedness Across Farm Sizes in India (2003)

Farm Size in Hectare	Prevalence of Indebted Households (Percent of Total Rural Households)	Amount of Outstanding Loan (USD)
Less than 0.01	45.30	136.02
0.01–0.40	44.30	145.44
0.41–1.00	45.60	191.62
1.00–2.00	51.00	305.82
2.00–4.00	58.20	521.24
4.00–10.00	65.40	945.16
Greater than 10	66.40	1,694.04

Source: NSS (2005b)

Table 4.11: India, Indebtedness by States (2003)

State	Indebted Farmer Households (Percent in Each State)	Average Loan Per Household (USD)
Andhra Pradesh	82.00	532.56
Tamil Nadu	74.50	532.51
Punjab	65.40	923.91
Kerela	64.40	753.49
Karnataka	61.60	403.00
Maharashtra	54.80	377.18
Haryana	53.10	577.93
Rajasthan	52.40	408.27
Gujarat	51.90	345.02
Madhya Pradesh	50.90	315.96
West Bengal	50.80	242.91
Bihar	33.00	99.47
Jammu and Kashmir	31.80	42.29
Assam	18.10	18.07
All India	48.60	279.67

Source: Ministry of Finance (2007)

Table 4.12 shows the scenario of farmer suicides across states. As Table 4.12 shows that farmer suicides, a manifestation of farm crisis, have been largely concentrated in Andhra Pradesh, Maharashtra, Karnataka and Kerela,[80] states with high levels of indebtedness. While the state of India's agricultural sector is problematic, the condition of farmers in low irrigation, low rainfall tracts of the above-mentioned states is critical. Areas prone to droughts are particularly under stress.

[80] The reports mentioned below show the status of affairs across major states in the country. Thus, using Gujarat as an example for the success of Bt cotton in raising agricultural productivity cannot be considered as the state of affairs across the country.

Table 4.12: Farmers Suicides in India by States (2001)

States	Number Of Farmer Suicides	Farmer Suicides (Percent Of All Suicides)
Maharashtra	3,536	24.20
Karnataka	2,505	21.10
Andhra Pradesh	1,509	14.30
Chattisgarh	1,452	36.10
West Bengal	1,246	9.10
Kerela	1,035	10.80
Tamil Nadu	985	8.70
Uttar Pradesh	709	18.50
Gujarat	594	9.50
Orissa	256	6.30
Haryana	145	7.20
Pondicherry	91	17.20
Bihar	88	10.30
Punjab	45	6.90
Tripura	41	4.80
Himachal Pradesh	22	7.20
All India	16,336[81]	15.20

Source: Nagaraj (2008)

Facing the Economic and Ecological Challenges in Vidharbha

In sum, farmers in Vidharbha and other rainfed areas of India live in ecologically and economically fragile environments. They face a large number of problems including water scarcity, persistent pest attacks, low availability of credit, poor marketing networks and indebtedness. They do not resemble the "progressive farmers" of the Green Revolution, who were economically and ecologically sound and because of their well entrenched economic and ecological position were able to make "certain" profits from the Green Revolution technologies.[82] Given the wide variety of

[81] Sum of all suicides.

[82] While Gujarati farmers could be noted as progressive farmers, who used Bt cotton to produce greater yields, this is a rarity and their success has been built on a number of other factors including a superior

economic and ecological constraints, it is unlikely that GM technology can solve these problems. Solutions to the farm crisis will also depend on the broader policy and institutional environment which forms the subject matter of Chapter 5.

hybrid (germplasm rather than technology) and the greater strength of farmer networks for sharing and distributing the illegal seeds (Roy: 2007).

Chapter 5

POLICY AND INSTITUTIONAL ENVIRONMENT

Bt cotton has been introduced and adopted in India's cotton belt through a collaboration between the agro-transnational corporation Monsanto and the Indian seed company Mahyco. The technology was introduced in a period of economic reforms and liberalization, where the level of policy and institutional support for introducing transgenic technology to cotton producers was thinner than what was available to wheat farmers during the Green Revolution. Such policy and institutional support was an integral component in the adoption of Green Revolution technologies. This support included political will at the highest level of the state (see Chapter 3) where great importance was accorded to the role of farmers in increasing agricultural production as well to increasing their income. The support included the creation of a massive research, development and extension infrastructure for the adoption of new technologies at both national and local levels. It also included subsidies for seeds, water, fertilizers, and irrigation as well as grain procurement, making the adoption of new technologies "safe and remunerative" for wheat and rice farmers. Similar policy and institutional supports do not exist in the adoption of GM technology.

Bt cotton was introduced in India without any closure to the controversy regarding the benefits and risks of this new technology. The Indian government later enacted a national policy that would examine the benefits of biotechnologies for various categories of crops and farmers. Initially, the Bt seeds were high priced. A national level pricing policy for Bt cotton was formulated later after intervention by the state of Andhra Pradesh and the Indian judiciary. In contrast, greater state support was provided by the Indian state to the multinational seed industry through the protection of intellectual property rights and non-regulation of Bt cotton prices.

Diffusing Bt cotton without extension institutions appropriate to rainfed areas limited the likelihood of farmers making gains from GM technology.[1] Subsidies for irrigation, power, fertilizer, water and credit available to farmers with irrigated lands have been unavailable to the farmers in Vidharbha and other rainfed areas of India. Through the concerted action of farmer movements, the economic problems of rainfed areas (and agricultural sector) received greater attention in public policy in the year 2009. Agriculture as a sector has been a prime focus of the 11th Five Year Plan (2007–2012) which has led to an increase in the rural welfare budget.[2] In sum, Bt cotton and GM technologies have been, and are being adopted, under local and national policy and institutional conditions that do not create a predictable environment for farmers to make profits in rainfed areas such as Vidharbha. This chapter will elaborate on what these local and national policy and institutional conditions are under which Bt cotton was adopted in Vidharbha.

Liberalization Policies

While the Green Revolution technology was adopted during a period of food crisis, the national political atmosphere was quite different during the adoption of Bt cotton. India was no longer a country suffering from a food crisis, dependent on food aid and living a hand-to-mouth existence. Already in 1984, India was being fashioned into a country inspired by the success of East Asian countries such as Korea, a high tech India, strongly placed in the global economy (Corbridge and Harris 2002). It was during this period that the state gave incentives to the information technology (IT)

[1] This stands in stark contrast to the extensive nature of extension services that were provided during the Green Revolution period. The state agricultural universities and local departments conducted demonstration programs and supplied free kits to the farmers. The seeds were modified in the government labs to suit Indian conditions.

[2] Interview, R.B. Singh, Member, National Commission of Farmers, Delhi, April, 2007.

sector. During this period, the government reduced corporate and personal income taxes to give incentives to the private sector, and shortened the list of items reserved for the small scale industry. The financial budget of 1985 also cut import duties on capital goods and provided tax breaks to exporters (Corbridge and Harris 2002). As the government was getting warmer towards the private sector, the increased government spending on defense, loan waivers and subsidies went unmatched by increases in government taxes and receipts. The Gulf War added to the woes of increasing oil prices. Ultimately, the Government of India chose to finance its deficits by borrowing from captive financial institutions at home and from commercial banks abroad.

By 1991, India was suffering from a fiscal deficit that was 9% of the GDP, which in turn impacted its balance of payments (Corbridge and Harris 2002). India's foreign exchange reserves were down to two weeks of imports, despite an International Monetary Fund (IMF) loan of 1.8 billion USD in January 1991. According to Joshi and Little (1996), India's credit rating was so low that commercial borrowing was impossible. The financial crisis had been simmering for a while as the Indian state had been meeting the increase in its agricultural subsidies by borrowing from abroad.

The balance of payments crisis led India to the doors of the IMF in 1991, which had already been promoting structural adjustment programs (SAP) as a conditional basis for lending to developing countries.[3] The economic reforms aimed to integrate India into the global economy through changes in trade policies, exchange rates and industrial policy. The economic reform program had a two-fold strategy:

[3] Much of the literature on the adoption of Indian reforms (Basu: 2001, Sachs, Varshney and Bajpai: 2003) fail to point out international sources that aided the adoption of economic reforms. The debt crisis of the 1970s steadily worsened in the 1980s and placed developing countries in a weak bargaining position with the World Bank and IMF.

macro-economic stabilization on one hand and structural adjustment on the other. The macro-economic stabilization program was designed to tackle the balance-of-payments problems and ensure budgetary stability. It consisted of the rupee's devaluation by 18%, reduction in fiscal deficit through expenditure compression, tax reforms, partial privatization and provision of signals to public sector undertakings to operate on a commercial basis (rather than a social one).

These measures were supplemented by a transition to a market driven exchange rate system, permitting select Indian corporations to raise funds from the international capital market and encouraging capital inflows by way of foreign institutional investment, foreign direct investment (FDI) and NRI deposits. The financial sector saw major reform through the partial privatization of a number of public sector banks and financial institutions and the entry of private banks (Rakshit 2004).

Sector wise, after the economic reforms, changes in industrial policies included removal of capacity controls by "dereserving" or "delicensing" industries or abolishing the requirement to create new capacity or to expand existing capacities of industries substantially. As a result of dereservation of areas hitherto reserved for the public sector, there were only nine industries for which entry by private investors was regulated. A second area of industrial reform is related to the Indian government's encouragement of foreign equity investment in the Indian economy. In order to do this, the government provided incentives to foreign equity investment of up to 51% in high priority industries, encouraged foreign technical collaboration into these same industries and allowed non-resident Indians (NRIs) to have 100 percent equity in existing or new companies operating in India (Corbridge and Harris: 2000).

These reforms were sea changes in India's policies, as India transitioned from a hitherto closed import-substitution economy to a more open export-oriented one.

According to Krueger (2002), before 1991, India's foreign policy saw foreign investment as a necessary evil while foreign firms saw it as a place that was more trouble than it was worth for investing their money. The foreign firms entered India by ceding the lead role to an Indian firm, but leaving the management control firmly in the hands of an Indian partner who controlled the key success factor of obtaining an industrial license. After 1991, foreign firms could then invest more freely in India. The liberal norms of investment changed the foreign firms' perception of the Indian market as they discovered a middle class that was clearly going to be India's top market in a few years (Krueger 2002).

Another major change that occurred due to economic reforms was the liberalization of import trade. The Indian state diluted import controls by rapidly reducing the number of tariff items that were subject to quantitative restrictions, licensing and other forms of discretionary controls of imports as well as cutting tariff rates on a range of commodities. By the middle of 1998, 7,000 items could be freely imported under the open general license (OGL) schemes. The process of tariff reduction has not been uniform across industrial sectors. Imports of capital goods have been substantially liberalized by placing them under the OGL scheme, by reducing tariffs and by offering concessional duties for project imports accompanied by fairly wide ranging liberalization of the import of consumer goods which have been placed on the OGL list, so that very few items remain on the negative list of imports (Ghosh and Chandrasekhar 2002).

In the case of the agricultural sector, the economic reforms initiated in 1991 did not contain a package specifically aimed at this sector (Ghosh and Chandrasekar 2002).[4] However, there were parts of reforms that did impact this sector, and among

[4] According to economist Abhijit Sen (1992), during the Structural Adjustment Program of 1991, the World Bank Country Economic Memorandum Paper relating to agriculture suggested the following reforms: (a) reducing agriculture subsidies; (b) regaining control of public expenditure; (c) improving the safety net offered by food programs while restraining costs; (d) initiating credit reforms to prevent

this upheaval of reforms, the most significant change was a certain silence or lack of policies which defined the policy and institutional package for adoption of transgenic technologies.

The Technology, Policy and Institutional Support for Bt Cotton

A necessary condition for the successful dissemination and use of public sector HYVs was not only the technology, but also the supportive policy and institutional environment. This supportive environment consisted of subsidies and incentives such that farmers would adopt new technology. These incentives were critical to profit making from new technology. What is the nature of the policy and institutional environment available for adoption of GM cotton to farmers in Vidharbha, and how does this shape their possibilities for making a living?

Technology of Genetically Modified Cotton: GM cotton is created by inserting a toxic bacterium called Bt (a toxin produced by the soil bacterium *Baccilus Thureigensis*) in the selected germplasm, compared to the Green Revolution technology, which was a high yielding cross-breeding technology. The Bt toxin enables the cell to encode for an insecticidal protein "Cry1ac" Bt gene, resulting in conferring immunity to the cotton plant against a group of insects (Bhagavan and Virgin 2006), especially the American Bollworm (Planning Commission 2006). In the case of GM seeds, genes for traits thought to be advantageous from any living organism can be spliced into any crop variety. Using genetic engineering genes from an organism, that organism can be mapped, isolated and transferred to: 1) another organism of the same species, e.g., a pest-resistant gene from one tomato variety can be transferred into another tomato variety; 2) an organism of a different species, e.g., a

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the collapse of the agriculture credit system; and (e) ending coercive marketing and trade restrictions. However, none of these were adopted (adapted from Sen: 1992).

gene from a tomato can be transferred into rice; or 3) an organism belonging to a different kingdom, e.g., a gene from a firefly transferred into a tobacco plant (Mumbaku 1998). Bt has to be eaten by the insect to cause its mortality. Bt toxin dissolves in the high pH pest gut and becomes active. The toxins then attack the gut cells of the insect, punching holes in the lining of the gut. The Bt spores spill out of the gut and germinate in the insect, causing death within a couple of days. The performance of the Bt varieties depends crucially on the availability of adequate and reliable irrigation and the quality of input supplies (Vaidyanathan 2006). What kind of policy and institutional support accompanied the adoption of Bt cotton?

GM Development and Biotechnology Policy: In the case of GM crops, by the mid-1980s, international trends in plant breeding technology had established biotechnology as the new face of commercial agriculture. The value of genetic manipulation has always impressed Indians since the 1960s when the high yielding varieties were introduced on Indian farms (Rajan 1996). The Indian state, which was a premier state in the adoption of the Green Revolution technologies, already boasted a strong conventional plant breeding establishment. Global trends in biotechnology had since then been closely watched by the Indian state. In the sixth five year plan (1980–85), the Indian state declared that genetics would be a new priority area of public policy and set up a National Technology Board in 1982 (Rajan 1996). In 1986, to build indigenous capacities for biotechnology development in line with international trends, the Indian government established the Department of Biotechnology.[5] Despite the Indian state's positive stance towards biotechnology development and the establishment of this department, there was no national level policy per se as in the

[5] Rajan (1996) provides a north-south angle to the development of the biotechnology industry. According to Rajan, the Indian state as it became aware of new developments in biotechnology in the North became concerned that the lack of access to this technology would further widen the development gap between the North and South. In the negotiations for the Convention for Biological Diversity, the Indian state argued for technological transfer and location of gene banks in India.

Green Revolution times towards biotechnology and its relationship to the problems of the agrarian sector, food security or economic development.

In 1993, Monsanto, an agro-transnational corporation that had been operating in India as a pesticide company since the 1950s, approached the Indian government to sell the transgenic technology or the "Cry1ac" Bt gene[6] at a price of 666,666[7] USD. This was refused by V. L. Chopra, a Planning Commission member[8] because of the high costs of the transgenic genes to the public funds (Bhatia 2001). Around the same time, the Indian government approached the Japanese government under a World Bank Program to buy a "Cry1b" gene, which contained the same traits of warding off the Bollworm pests as the Bt gene did. However, this gene failed to provide the results that later Bt gene would produce in the Gujarat cotton fields.[9]

The advent of liberal policies towards foreign firms and investments, post-1985 and gaining momentum after 1991, facilitated Monsanto's collaboration with the Indian seed firm Mahyco, a big seed company established in India in 1964. This collaboration was precipitated by the 1991 economic policies that allowed foreign firms to own 50% of equity shares in Indian ventures. Already, the 1988 National Seeds Act encouraged the entry of foreign-owned and large Indian firms in the seed sector and eased regulations on technology transfer (Pray and Ramaswami 2003). Meanwhile, in 1993, the opposition to transgenic seeds started coalescing and occupying various protest forums in India. The environmental movement, most prominently led by Vandana Shiva, provided prolific coverage against GM crops

[6] Hithertho the "Cry1ac" Bt gene would be referred to as the Bt gene.

[7] Rs 3 crore= Rs.30,000,000/45=666,666 USD

[8] Interview, Bhagirath Chaudhury, ISAAA, Delhi, July, 2006.

[9] Interview, Padmanabhan, CICR Scientist, Nagpur, Maharashtra, 2006.

through the Internet, campaign websites and newsletters.[10] Activists like Shiva called attention to the potential risks of GM crops on biodiversity and agriculture, the threat of dominance of foreign multinationals over Indian agriculture and the fear of the bondage of farmers to seed industry multinationals (Herring 2005). Opposition constituted by a section of farmer movements, primarily the Karnataka Rajya Ryotha Sangha (KRRS), occupied other forums for protests such as burning field trial plots of Bt cotton in 1998 in Karnataka, destroying the seed company Cargill's[11] office in Bangalore in 1993, uprooting trial fields and staging demonstrations against GM crops and multinationals (Herring 2005).

Citizen juries and workshops that discussed principles of locally led rural development, initiated by groups such as the Deccan Development Society, were also held in Andhra Pradesh and Karnataka (Scoones 2006). Small groups practicing organic and sustainable agriculture created other forms of protest against GM crops.[12] The ambivalent stance of the Indian government towards biotechnology was revealed in an incident in May 2001 when illegal Bt seeds were found growing in many hectares of fields in the state of Gujarat (Herring 2005). The central government ordered the destruction of the seeds, but the state government refused to destroy the crops (this incident was later cited by pro-GM groups as a success of the GM crop technology).

On the other hand, the pro-biotech alliance, which included a segment of the farmer movement, the seed industry, multinational seed companies, bio-pharmceutical

[10] For instance, see: http://www.navdanya.org/, or http://www.gmwatch.org/archive2.asp?arcid=4245 or http://www.genecampaign.org/News/news-gmcrops.html

[11] Cargill had opened a new office in the southern city of Bangalore in 1993.

[12] These groups include the Deccan Development Society located in Andhra Pradesh: http://www.ddsindia.com/www/default.asp

entrepreneurs, the central Indian state and federal states[13] led a strong campaign for GM crops, holding workshops, initiating policy dialogues and sponsoring large conferences to which policy makers were invited (see Chapter 2 for some of these statements). GM seeds were promoted, embedded in the liberal discourse of "making Indian agriculture competitive in the global market," "India should shed its conservative stance on GM crops" and "Bt cotton is providing the right policy signals for global venture capitalists to invest in India" (cited in Scoones 2006).

The Indian seed industry formed a number of associations with alliances developing within the seed industry and with seed multinational companies such as the All India Crop Biotech Association, containing members who were previously with the government.[14] The cause of the biotech industry was also led by the Confederation of Indian Industries, an umbrella body of Indian industries. The opposition to GM crops and Bt cotton was greatly celebrated or denigrated in academia and in popular print. However, its real effects on GM policy making were minimal, especially in regard to the introduction of GM crops (Scoones 2006). Its chief proponents such as Vandana Shiva, Research for Science, Technology and Ecology or Suman Sahai, Gene Campaign were often invited by the government to discussions relating to agricultural issues and were present in a number of farmer meetings that are held in Delhi or other parts of the country.[15] For instance, Vandana Shiva was present in the farmer meeting

[13] The success of the information technology sector formed the basis of the political discourse of states in promoting biotechnology. For instance, the Chief Minister of Karnataka in his budget speech for the year 2000-2001 noted, "While Karnataka is the acknowledged leader in IT, I would like the State to lead the next revolution in Biotechnology." See: HinduBusinessLine. "B for Bangalore and Biotech." HinduBusinessLine, 5 June 2001. Accessed at.http://www.hinduonnet.com/businessline/ 2001/05/07/stories/100767g1.htm

[14] For instance, R.K. Sinha, the head of the All India Biotech Association, was previously with the Ministry of Environment and Forests.

[15] Interview, Bhagirath Chaudhari, ISAAA, Delhi, July, 2006.

titled "WTO ki padi hai maar" held in 2006 at the India International Center, Delhi[16] which was attended by political leaders such as V. P. Singh (a former Prime Minister), Prakash Karat (Communist Party of India) and Vijai Jaywandhia (Shetkari Sangathana). Using strategies such as public interest litigations and petitioning the Genetically Engineering Approval Committee (GEAC),[17] the environmental movement made important interventions in the creation of the hitherto non-existent biotechnology policy and the formulation of a bio-safety policy.[18] After a substantial protest was raised by organizations such as the Gene Campaign (see Sahai 2004), a Task Force for evaluating agricultural biotechnology was formulated in 2003[19] and a biotechnology policy in 2004.

The environmental movement also raised issues such as the deleterious effects of Bt toxin on sheep during the biosafety approval process under the GEAC.[20] Overall, however, the movement has been successful in creating only a discursive space (Scoones 2006) providing an enhanced sense of democracy in policymaking[21] and delaying the regulatory process (Scoones 2006). Scholars such as Herring (2006) attribute the failure of these movements to the non-representativeness of these

[16] This is a popular place for social movements to meet and lobby political leaders in Delhi.

[17] GEAC is a central level body constituted under the Ministry of Environment and Forest that approves GM trials.

[18] For instance, see: India needs a biosafety policy: http://www.hinduonnet.com/fline/fl2110/stories/20040521001708200.htm. Biotech Policy: Secretive and Hasty. http://www.indiatogether.org/2006/apr/agr-btpolicy.htm#continue

[19] Interview, Bhagirath Chaudhary, Masters in Business Administration, Interview, ISAAA, Delhi, April, 2006.

[20] Interview, Bhagirath Chaudhury, ISAAA, Delhi, April, 2006.

[21] Comment, Shiv Vishwanathan, Social Scientist, Center for Study of Developing Societies, Delhi, July, 2006. This stands in stark contrast to the policy making during the Green Revolution period when the policymaking was more closed door in nature but were created prior to the introduction of the new seeds.

movements of the farmer's problems and the class position of those who led the movement. He argues that such a stance is only available to certain classes, which the environmentalists represent and not farmers who cannot afford their ideology. He says that farmers are driven by necessity, unlike the activists, for whom controversy is the mode of production. However, the power of the seed industry, which has been increasing due to government support to the industry since the 1980s, is the real reason why GM crops were successfully introduced in India in 2002. Given the nature of events regarding the introduction of Bt cotton, the closure to the GM crop controversy is a "rhetorical closure," one that occurs not because a controversy ends with the emergence of a neat solution, but when a particular social group considers the problem to be solved (Misa 1992). After the introduction of Bt cotton, a national level policy on biotechnology was formulated with the creation of the National Task Force on Biotechnology in 2004 (The Hindu, 3 Jan 2004).

The 2004 National Task Force on Biotechnology recommended that the transgenic approach should be considered as complementary and resorted to when other options to achieve the desired objective are neither available nor feasible. This approach should also not be conducted in crops where international trade might be affected (Swaminathan 2004). While the state has created stringent policy towards regulation of the economic and environmental risks of GM crops that follows the "precautionary principle" approach to regulation, such comprehensive appraisals are not conducted in practice for GM crops such as GM mustard or brinjal which have to clear biosafety regulations.

Seed Prices: In 2002, three varieties of Bt cotton: Mech 12, Mech 162 and Mech 184, all produced by Mahyco-Monsanto, were introduced for use in four cotton growing Indian states, namely, Maharashtra, Gujarat, Tamil Nadu and Karnataka (ApCOAB 2006). Examining the supply of Bt gene in the 60 varieties that have been

released across India, it appears that Bt gene has been supplied by the agro-transnational, Monsanto in 58 cases. In only two cases have the genes been supplied by companies other than Monsanto, one being sourced by JK seeds from China and another developed indigenously by Indian Institute of Technology, Kharagpur.[22] Thus, unlike the ownership of the Green Revolution plant breeding material, which was held by the public sector, the ownership of Bt gene is largely held by an agro-transnational corporation, Monsanto. While Monsanto has supplied the Bt technology, sub-licensees such as Mahyco have supplied the germplasm for the seed which was already in use under Indian field conditions.[23] The majority of Indian seed companies did not and still do not possess the technological know-how for producing the Bt gene themselves. Therefore, the ensuing exchange that took place between multinational capital and Indian capital has allowed the primary R&D capacity to stay in the hands of multinational capital (Evans 2006).[24]

This monopoly affected the final price at which Bt cotton was introduced in the market. The price of a regular Bt packet of 450 gms was 40 USD[25] in 2002, out of which 20 USD[26] was the royalty fee of Monsanto.[27] This price was three times higher than the price of non-Bt hybrid seeds, and several times the costs of open or straightline (non hybrid) varieties that were being used by farmers earlier due to the high cost of intellectual property rights. The price of a non-Bt hybrid such as Ankur,

[22] Interview, Bhagirath Chaudhury, ISAAA, Delhi, July, 2006.

[23] Interview, Bhagirath Chaudhury, ISAAA, Delhi, April, 2006.

[24] A division of labor of this kind between the center and the periphery is common when technologies are transferred from the center to the periphery.

[25] Rs. 1,800=Rs 1,800/45=40 USD.

[26] Rs. 900= Rs. 900/45=20 USD.

[27] Interview, Pankaj Shiras, JK Seeds, Nagpur, Vidharbha, July, 2006.

which is popular in Vidharbha, is 13.33 USD[28] in 2002.[29] This price was also high for the Indian seed industry. For instance, Pankaj Shiras of JK seeds claims that "Monsanto's actions are tantamount to neocolonialism in terms of the high prices that they are charging."[30]

Price regulation of the expensive Bt seeds came into the picture when the state of Andhra Pradesh filed a petition to the Monopoly and Restrictive Trade Practices Commission (MRTPC) against Monsanto (Tehelka 2006). The state of Andhra Pradesh challenged the exorbitant royalties charged by Monsanto and the difference in royalty costs charged in India versus the United States. The state asserted that for every 450 gm of seeds sold, Monsanto charges 26.6 USD[31] as "trait" charges from its Indian licensees while it charges 2.4 USD[32] from its licensees in the United States (The Hindu, 3 January 2006). The state of Andhra Pradesh was supported by the agricultural ministers of seven cotton growing states ─ Gujarat, Karnataka, West Bengal, Tamil Nadu, Madhya Pradesh, Maharashtra and Andhra Pradesh as they signed a common memorandum of understanding to fight a legal battle against Monsanto (USDA 2006). Three states then ordered the sub-licensees of Monsanto to lower the seed prices to 16.66 USD.[33] They warned the companies that if they did not lower the price, then the states would be forced to challenge them under the Essential Commodities Act (Times of India, June 2006).

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[28] Rs. 600=Rs. 600/45=13.33 USD.

[29] Interview, Pankaj Shiras, JK Seeds, Nagpur, Vidharbha, July, 2006.

[30] Interview, Pankaj Shiras, JK Seeds, Nagpur, Vidharbha, July, 2006.

[31] Rs. 1,200= Rs 1,200/45=26.66 USD.

[32] Rs. 108= Rs. 108/45=2.4 USD.

[33] Rs. 750=Rs 750/45=16.66 USD.

Monsanto approached the Supreme Court of India seeking a stay on the implementation of MRTPC's order and questioned the jurisdiction of the MRTPC to adjudicate the price issue. Monsanto argued that the "licensing of technology does not fall under the classification of goods or services." Monsanto asserted that the royalty was being charged for transfer of technical know-how and not sale of goods, which is what the commission regulates. Monsanto also suggested that the term "royalty" could not be applied because this technology does not hold a patent in India. Additionally, Monsanto said that there was an absence of rules in India for determining prices that a technology provider could charge from its sub-licensees (The Hindu, May 2006). The MRTPC case led to a reduction in the price of Bt cotton to 16.66 USD for a 450gm packet in 2006.[34] The seed industry claims that the seed costs were high because of the lengthy process of conducting biosafety regulations by the Indian state (Pray, Bengali and Ramaswami 2005).[35] It also claims that greater competition in the seed industry can bring GM seed prices down.[36] In reality, Monsanto continues to have a monopoly over the transgenic seed market due to the high cost of developing the Bt gene.

Unlike the Green Revolution period, when the state donated the germplasm to the private sector, similar state support did not exist for helping the indigenous seed sector to develop GM technology.[37] The price ceiling that was applied to the Monsanto seeds to decrease their price is disadvantageous for the Indian firms that have entered the Bt market late and are hoping to develop their own Bt gene.[38] Such GM

[34] Interview, Pankaj Shiras, JK Seeds, Nagpur, Delhi, 2006.

[35] Interview, Bhagirath Chaudhury, ISAAA, Delhi, 2006; Ronald Herring, Cornell University, February, 2009.

[36] Interview, Bhagirath Chaudhury, ISAAA, Delhi, 2006.

[37] Interview, Pankaj Shiras, JK Seeds, Delhi, 2006.

[38] Interview, Bhagirath Chaudhury, ISAAA, Delhi, 2006.

development would have led to a lowering of the price of Bt gene. With the release of more varieties by Monsanto-Mahyco Biotech (MMB), there is already a restriction in the market because many sub-licensees are bound to MMB by contract (Murugukar, Ramaswami and Shelar 2007). At present, MMB has licensed its Bt gene to almost all leading cotton seed companies. These firms are contractually bound to pay royalties to MMB (Murugukar, Ramaswami and Shelar 2007). Thus, competition amongst these firms cannot lead to a lowering of prices. The government has recognized the importance of inserting the Bt gene in a cheaper, public, non-hybrid variety. For instance, M. S. Swaminathan at the CSE-NCF Roundtable on Farmer Suicides noted "Bt in straightline (non-hybrid) varieties will be more effective. In China there are no hybrids in Bt cotton use."[39] A number of straightline (non hybrid) varieties containing the Bt gene are under development at the Central Institute of Cotton Research, Nagpur.[40] However, these are yet to be released in the market. In 2002, the shelves of the local input dealers in Vidharbha were largely stocked by MMB varieties rather than public sector varieties (Author's observation, July, 2006).

Whether farmers' returns are certain or not, the royalty that was being charged by Monsanto (and its associated profits) are "certain" in comparison to the farmer's profits from Bt technology. Chapter 4 on Vidharbha describes the nature of economic uncertainties or problems farmers face in cotton production which affect the "certain" creation of profits. Once the seed is sold, the profits belong to Monsanto, but given that the farmer has to deal with both economic and ecological uncertainties in rainfed areas as well as the lack of a safe and predictable production environment (as existed

[39] Interview, M.S. Swaminathan, Plant Breeder, CSE-NCF Roundtable on Farmers Suicides, Pusa Institute, Delhi, July, 2006.

[40] Interview, Padmanabhan, Senior Scientist, Entomologist, Central Cotton Research Institute, Nagpur, 2006.

during the Green Revolution), large seed companies such as Monsanto are made sure winners in the transgenic seeds market.

The state regulation to control prices has only emerged after activist intervention by federal states and the judiciary once the seeds have been introduced in the market. However, the presence of laws for intellectual property rights has allowed firms like Monsanto to make stable and certain profits. Although there is no de jure protection for Monsanto's gene construct, there is de facto protection because the central government of India has allowed Monsanto to transfer the seed having the known gene construct for crossbreeding with the germplasm of sub-licensee seed firms (Roy 2007). Why do farmers continue to buy these seeds despite their high costs? According to Keshav Kranthi, entomologist, Central Institute of Cotton Research, Nagpur, this situation exists because "these were the only varieties available for addressing the pest menace that had been affecting cotton production for over a decade and no sustainable solution had been found to date."[41] Furthermore, according to farm activist, Vijai Jaywandhia of the Shetkari Sangathana, Wardha, Maharashtra, these new seeds were marketed aggressively through advertisements in local newspapers and field meetings held for farmers by the local seed companies. "The seed companies put large advertisements which said that the Bt will fight the bollworm with all its might."[42] Pankaj Shiras, old time seed dealer, JK seeds, Nagpur, adds: "the Bt seeds created a hype amongst farmers due to the controversy that surrounded Bt seeds, leading to greater sales of Bt seeds."[43]

[41] Interview, K.R. Kranthi, Senior Scientist, Central Indian Cotton Research Institute, July, 2006.

[42] Interview, Vijai Jaywandhia, Farmers Leader, Shetkari Sangathana, Wardha, July, 2006.

[43] Interview, Pankaj Shiras, Seed agent, JK Seeds, Nagpur, July, 2006.

Unregulated Markets of Bt Cotton: The introduction of Bt cotton has also been associated with a growing informal market in illegal Bt cotton seeds.[44] In the case of the Green Revolution, no such market was noticed as a very clear policy, and an institutional framework was in place wherein HYVs were produced and diffused by a well-connected network of national and regional agricultural research centers. "Since the Green Revolution seeds were hybrids and in the public domain, there was a smaller incentive for profit making by the private sector."[45] However, in the case of the GM seeds, especially those that are introduced in rainfed areas, the development and diffusion of the seeds has been driven entirely by the private sector. As the section above indicates, this phenomenon has led to seeds being sold at a high cost. It has also led to the creation of an informal market of illegal (non branded) Bt seeds.

The illegal seeds were first discovered in mid-October 2001 when reports came to the forefront of actual fields in thousands of hectares of illegal Bt cotton growing in the state of Gujarat (Herring 2005). A local seed company, Navbharat 151, developed this so-called illegal variety through a strain selected from an indigenous germplasm collection (Down to Earth 2006). The activities of the company were supported by the state of Gujarat, as the company got state support for seed research (Down to Earth 2006). This variety, which had already been popular in Gujarat before Bt came to the market, was fused with the Bt gene by its breeder, D. B. Desai.[46] It produced such good results in the field that during a pest attack in 2001, it was the only variety that survived and produced good yields (Down to Earth 2006). Not only was productivity good (1.2 to 1.5 Metric Tonnes per hectare), which was better than imported varieties,

[44] Such informal markets have developed in most developing countries when the prices of the goods needed are high.

[45] Interview, Harish Damodaran, Associate Editor, Hindu Businessline, Delhi, July, 2006.

[46] This was possibly stolen by Navbharat seeds from Monsanto. Interview, Bhagirath Chaudhury, ISAAA, Delhi, July, 2006.

but also the price at which Navbharat 151 was available was 13.33 USD per packet (Down to Earth 2006). This price was equivalent to the price of normal hybrid seeds such as Ankur in Vidharbha. Someone filed a complaint against Navbharat that these seeds contained the Bt gene, which was Monsanto's property. Because Navbharat had no license for Bt technology, the central government declared Navbharat seeds illegal and ordered the Gujarat government to burn the cotton fields (Down to Earth 2006). When Navbharat–151 was banned, it simply went underground. Though the company was stopped from producing and marketing seeds, farmers started circulating the seeds and small seed farms, about 300 in number, started producing them (Down to Earth 2006). The farmers developed this variety through cross breeding and the strains were selling at a price even cheaper at the rate of 2.22–4.44 USD[47] per packet (Down to Earth 2006). In the season of 2005, the Navbharat varieties and its variants covered 80% of all Gujarat area despite a pest attack (Down to Earth 2006). Given the vast area of cotton coverage, the state, both central and federal, has been unable to regulate the spread of this variety. It also does not possess the "capacity"[48] to regulate such a vast area of cotton.

As the popularity of this illegal variety increased, Bt seeds started spreading into other cotton growing states including Vidharbha, Maharashtra (Centre for Science and Environment 2006). They were sold in open and closed packets by unregistered and registered seed agents who made profits based on their popularity amongst farmers.[49] As Pankaj Shiras, a licensed seed agent of JK seeds in Vidharbha, Maharashtra, explains, "We sold them for a season before the government started a

[47] Rs. 100=Rs 100/45=2.22 USD and Rs. 200= Rs 200/45=4.44 USD.

[48] Notions of state capacity are developed in Francine Frankel (2005).

[49] Interview, Pankaj Shiras, JK Seeds, Nagpur, Maharwashtra, July, 2006.

crackdown of the illegal seeds."[50] The cost of the seeds was 13.33 USD, much lower than the cost of the branded Bt seeds. According to Pankaj Shiras of JK Seeds (Vidharbha), during the 2006 cotton season, nearly 30% of the market was supplied through the non-branded seeds in Vidharbha.[51] The fact that the presence of illegal seeds in Vidharbha has been recognized by the government shows how big this market is in Vidharbha and other areas. For instance, the Deputy Chief Minister, R. R. Patil of Maharashtra remarked: "We have made arrests in Maharashtra as well as Gujarat in this case. The police will also take action against black-marketers of cotton seed. People must come to the police and register the offences" (HinduBusinessLine, 26 June 2005). Across the country, estimates suggest that illegal Bt occupied 26% of the total Bt cotton acreage in 2005–2006 (Rao 2006). In August 2004, the Agricultural Minister of India, Sharad Pawar admitted in the Indian Parliament that there was a flourishing illegal market in GM cotton seeds now growing in India, strengthening the allegations that a large volume of cotton growing in the country is from officially unapproved varieties (Roy 2007).[52] There was much uncertainty about whether these seeds contained the Bt gene and whether these would produce the kind of yields in the field as the Gujarat seeds or the Green Revolution seeds did.

In 2002, the official Monsanto seeds were introduced and three MMB varieties were adopted in cotton growing regions that included Vidharbha. However, despite the introduction of official seeds, the illegal seed business continued to function. According to Ashok, local dealer of Syngenta Seeds in Vidharbha, "The illegal seed market will die down in 2007 as price of the branded Bt seeds would come down so

[50] Interview, Pankaj Shiras, JK Seeds, Nagpur, Maharashtra, July, 2006.

[51] Interview, Pankaj Shiras, JK Seeds, Nagpur, Maharashtra, July, 2006

[52] There are contradictory estimates as to what volume of area is under illegal Bt cotton.

much that farmers will start buying the real seeds."[53] However, despite the decrease in prices of the branded seeds (see section on Monsanto and the Supreme Court case) and a crackdown by the local agriculture department,[54] this seed market was still flourishing in Vidharbha in 2006 and other parts of the country.[55] This is so because, even while the government lowers the price of the official seeds, the price of the illegal seeds can be lowered even further (Murugkar, Ramaswami and Shelar 2007). The presence of illegal seeds is not a problem per se. However, there is no quality control for illegal seeds. In states like Maharashtra, there is a high presence of illegal seeds that are spurious and which do not contain the Bt toxin. Still, not all illegal seeds are spurious in nature, especially in cases where there is a greater network among farmers or where these seeds have been operating for a longer period of time as in the case of Gujarat (see Roy 2007). In the state of Gujarat, there is a well defined network of seed producers and sellers. Also, farmers believe that illegal Bt coming from Gujarat is of good quality (Murugkar, Ramaswami and Shelar 2007). A similar center for illegal seeds has emerged in Kurnool, Andhra Pradesh. However, Kurnool Bt has more quality problems than Gujarat Bt and also other locales might lack the same kind of trust based network that had started to emerge in the case of Gujarat (Murugkar, Ramaswami and Shelar 2007).

The lack of regulation of illegal seeds produces a higher risk that they are spurious and of bad quality, especially when the costs at which they are available are low. The Planning Commission Report on Farmers Suicides (2006) notes, "Due to high costs of Bt cotton seeds the sale of spurious seeds by unauthorized agencies is

[53] Interview, Ashok, Syngenta Seeds, Nagpur, Maharashtra, July, 2006

[54] Interview, Ram Apte, Employee, Agricultural Department, Nagpur, July, 2006

[55] Interview, Sourav Mishra, Center for Science and Environment, Delhi, May, 2006

very common. The problem is more common in remote areas where farmers have no access to sales outlets."

When the illegal seed sales started affecting the profits of Monsanto, Monsanto asked the Central Institute of Cotton Research, Nagpur to develop a Bt testing kit which could test the presence of the Bt trait.[56] However, this kit, although developed by a government institute, continues to be available to farmers at a high price of 44.44 USD. This affected its widespread use by farmers. According to Ron Herring, Government Department, Cornell University, a reputed agrarian scholar, "A critical need for adoption of transgenic seeds is the creation of a seed certification agency which can help distinguish between transgenic and non-transgenic seeds."[57]

Uncertainty in the Expression of the Bt Gene: Bt cotton has been attacked by activists and dubbed a failure in terms of its field performance. For instance, Gene Campaign Director, Suman Sahai calls "Bt cotton a disaster." She notes that 60% of the farmers of Bt cotton in Maharashtra have not recovered their investments (Times of India, 2005). In 2002, activist Vandana Shiva suggested,

> The Bt cotton crop in Vidharbha has been badly affected by the root-rot disease, a disease of roots. It is believed that this disease is caused due to wrong selection of Bt genes developed in America and brought to India. Many farmers have recorded only up to 50% germination of seeds and many others had poor germination, which is suspected to be caused by both, drought and poor seed quality. (Shiva 2002)

Based on these reports by activists and complaints by farmers, a study of Bt cotton expression in the commercial varieties was undertaken by senior entomologist K.R. Kranthi (Kranthi et al. 2005) at the CICR in Nagpur in 2005. Kranthi, who carried out tests on eight commercial hybrids, namely, MECH 12, Mech 162, Mech

[56] Interview, K. R. Kranthi, Senior Scientist, CICR, November, 2006

[57] Interview, Ron Herring, Government Department, Cornell University, February 2009.

184,[58] RCH 2, RCH 20, RCH 134, RCH 138 and RCH 144 noted that "a critical condition for the Bt gene to take effect and lead to reduction in pests is the expression of the Bt gene." The expression of the Bt gene can vary with different hybrids, timing and growth stages of the cotton plant, different field conditions and seasons (Kranthi et al. 2005).

Kranthi et al. (2005) study suggested that the Bt gene expression levels were the lowest in the ovary of flowers and boll rind of green bolls, which constitute the favored site for bollworms to attack. He argued that while the studied Bt cotton varieties gave greater protection than hybrids, these initial varieties did not provide as much protection as provided by Bt varieties (specially NuCOTN 33B) that are available in the United States (75–90% protection against *Helivocerpa Zea*), China (>90% against *H. Armigera*) and Australia (80–90% against *H. Punctigera*). Kranthi et al. (2005) asserted that according to their data on the above-mentioned varieties, there has been >40% survival of the Bollworm larvae on squares, >70% on green bolls and >80% on flowers. Thus, the Mech varieties are able to reduce the Bollworm presence by 40%, which explains the differential rate of survival of Bollworm larvae in many parts of India, including Vidharbha.

Kranthi et al. (2005) further argued that the commercial Bt-cotton hybrids in India expressed less than the critical levels of Bt gene required for full protection against Bollworms late in the season and also in some plant parts such as the boll rind, square bract, bud and flower, which are the main feeding sites of Bollworm larvae. Moreover, bolls in Bt-cotton F–1 hybrid plants contain segregating seeds, among which only an estimated 75% would express Bt gene. Because seeds form the most

[58] These were also the initial hybrids released in Vidharbha in 2002.

preferred food source of Bollworms, at least 25% of seeds in bolls of a Bt-cotton hybrid field could support susceptible Bollworm populations, if infested.
The decline in expression also varies according to the parental varieties or germplasm (short or long duration). Economist Vinayak Deshpande, at Nagpur University, Maharashtra, argues that "The expression of the gene has been tailored for short-term American Bt varieties. Since a number of varieties in which the Bt gene was introduced were medium to long duration (160–180 days), and these were in turn adopted in Vidharbha, these were more susceptible to expression decline of the "Cry 1ac"Bt gene and consequently pest attacks."[59] According to Kranthi et al. (2005), medium-to-long duration hybrids, as was evident with Bollgard-MECH-162, Bollgard-RCH-2 and Bollgard-RCH-20, experience a decline of Bt expression faster than the rest of the varieties mentioned above which are short term in duration. However, farmers, especially in South and Central India, prefer these hybrids for their big boll size and superior fiber properties. It can be safely said that uncertainties exist in the expression of the Bt gene under different field conditions and choice of the germplasm or parental variety. Kranthi et al.(2005) add that Bt cotton hybrids in India may require more supplemental insecticide sprays than those used on Bt-cotton varieties by farmers elsewhere in the world. In the event of lack of regulation or extension mechanisms to bridge these uncertainties in the farmer's fields, the problems are left to the farmer to deal with, causing an increase in pesticide use and uncertain production costs.

Scientifically, while Bt cotton might reduce the need to spray insecticides, it does not completely eliminate the need to spray, as the toxin might not be able to express itself fully. Even while a farmer might have planted Bt cotton, there might be

[59] Interview, Vinayak Deshpande, Economist, Nagpur University, Maharashtra, July, 2006.

a need to spray pesticides and in a more precise manner. After planting Bt cotton, the farmer needs to scout for larva weekly in the fruiting parts of the cotton plant. There is an absence of extension programs on part of both the public and the private sector in Vidharbha to address these issues, which has led to increased cultivation costs due to pesticides spraying in many Vidharbha districts. Specifically, according to Narayanmoorthy and Kalamkar's (2006) empirical study of 150 farmers on adoption of Bt cotton in two Vidharbha districts, Yavatmal and Buldhana, farmers continued to spray pesticides due to lack of information and fears of pest attacks. They also sprayed pesticides on Bt cotton because there had been pest attacks. While the cultivation costs in this study were found to be higher in the case of Bt cotton versus non-Bt cotton, due to increased productivity, the profits from Bt cotton were higher.

Bt Refuge: The creation of a biosafety regulatory system is expected to ensure that GM crops present no significant risks to the environment, biodiversity and human health through risk assessments and field trials (Jaffe 2006). In order to ensure environmental and health safety, the biosafety regulations prescribe planting a refuge of five rows of regular cotton around each Bt cotton plot, or 20% of the area has to be covered with non-Bt cotton. According to Keshav Kranthi (2005), entomologist at CICR, Nagpur (Maharashtra), the strategy ensures that an appropriate area of non-Bt crops is cultivated in the vicinity of the Bt-transgenic crop in order to ensure the survival of susceptible insects. The presence of these insects would lead to the dilution of resistance alleles through gene flow from the refuge into the Bt-surviving insects. The susceptible genotypes, when mated with the survivors from transgenic plants, would result in a heterozygous progeny which would express susceptibility, especially if the resistant alleles are recessive in nature. In simple language, this means that non-Bt cotton planted within or around a Bt cotton field acts as a ‘‘refuge’’ for Bt-sensitive insects that will breed with Bt-resistant insects, thereby minimizing or delaying the

development of Bt-resistant insects. The refuge of non-Bt cotton is also supposed to act as a ‘‘pollen-sink’’ or border to prevent out-crossing of transgenic Bt cotton pollen. The refuge area supplies a source of wild type (non-mutant) insects to mate with possible resistant insects to produce nonresistant insects. There is, however, no consensus among the scientists on the function, size or best method to implement the refuge strategy. Furthermore, the refuge strategy is alien to farmers' age-old agricultural practices (Mumbaku 1998).

While it would be difficult to make a statement regarding the planting of refuges by all farmers of Vidharbha, available studies indicate that this procedure has not been a top priority of cotton farmers, especially small and marginal ones. According to Narayanmoorthy and Kalamkar's (2006) survey of 150 farmers in two Vidharbha districts, farmers (100 growing Bt cotton and 50 growing non-Bt cotton) belonging to small and marginal farmers have not planted the Bt cotton refuge. The reason for this is that the size of the fields is too small and there is inadequate information regarding the planting of a refuge and its merits vis-à-vis health and environmental safety.

Regulation and Agronomic Compatibility of Bt seeds in Rainfed Areas: The productivity of Bt cotton is also dependent on the presence of water and use of inputs such as fertilizers and pesticides. According to economist Vinayak Deshpande at Nagpur University, "Bt cotton requires water on a more regular basis to give productive yields than the local open varieties or hybrids,"[60] which is also the message that is listed on the Bt seed packages: "Best grown under irrigated conditions."[61] The Planning Commission report (2006) in their examination of yields of Bt cotton versus

[60] Interview, Vinayak Deshpande, Economist, Nagpur University, Maharashtra, July, 2006.

[61] Interview, Vijai Jaywandhia, Shetkari Sangathana, Wardha, Nagpur, Maharashtra, July, 2006.

non-Bt cotton indicated that "yield in irrigated plots was better compared to rainfed crops in Bt cotton hybrids; Bt cotton hybrids could not withstand the moisture stress compared to non-Bt cotton varieties; thereby the yield was affected." In an examination undertaken at a number of research stations by the Planning Commission advisory, the following results were found in terms of economic returns from Bt cotton under irrigated and non irrigated conditions (Table 5.1). Table 5.1 suggests that the returns on Bt cotton under irrigated conditions are higher than those for Bt cotton under non-irrigated conditions, 478.90 USD/ hectare versus 232.31 USD/hectare, which has led the Planning Commission (2006) to suggest that "while Bt cotton, in fact, does quite well in irrigated conditions, it does not do as well in rainfed conditions." Clearly, while Bt seeds might produce good yields under irrigated conditions, the lack of irrigation leaves farmers with uncertainties in yields despite sunk costs of purchasing high cost Bt seeds.

The local agricultural department posted instructions regarding the proper use of Bt seeds in several villages around the time when the Prime Minister came on a tour of the Vidharbha region for providing relief to the crisis hit region.[62] After the case of farmer distress, an extension system created largely by the private sector started to develop in Vidharbha. According to Pankaj Shiras, JK Seeds, Nagpur, "In the cotton season of 2005–2006, Mahyco-Monsanto has provided extension that covers 30% of the total areas in Vidharbha."[63] The Planning Commission (2006) further noted,

> There was an obvious lack of responsible advisory. This led to the wrong or uninformed choice by the farmers in adopting varieties of seeds which were not suitable for rainfed conditions, coupled with the last 3 years of low rains in an otherwise assured rainfall area.

[62] Interview, Villager, Karanjia village, Nagpur District, Maharashtra, July, 2006.

[63] Interview, Pankaj Shiras, JK Seeds, Nagpur, Maharashtra, July, 2006.

Table 5.1: Returns from Bt Cotton in 2005-2006[64]

	Bt Hybrids (Non-Irrigated) (USD/Hectare)	Bt Hybrids (Irrigated) USD/Hectare
Items of Cost of Cultivation	Costs/Hectare	Costs/Hectare
Ploughing	8.89	8.89
Stubble Picking	7.31	7.31
Preparatory tillage	17.78	17.78
Marking of Sowing	4.44	4.44
Farm Yard Manure once in three years	44.44	44.44
Seed Cost (.004 Metric Tonnes/Hectare in Non-Irrigated Areas,.003 Metric Tonnes/Hectare in Irrigated Areas)	47.44	35.56
Seed Treatment	9.78	7.33
Sowing	10.44	8.36
Fertilizer	31.07	62.13
Fertilizer Application	10.44	15.67
Hand Weeding (Twice)	31.33	31.33
Insecticides	27.98	42.27
Hoeings (Four times)	17.78	17.78
Spraying	31.33	31.33
Irrigation (Five Times)	0.00	83.33
Picking	66.67	111.11
Carting to the market	16.67	27.78
Supervision	31.33	31.33
A. Cost of Cultivation (Sum of above costs)	415.13	588.18
B. Interest on Capital at 7% of Cost of Cultivation (7% of A)	29.06	41.17
C.Total Cost of Cultivation (A+B)	444.19	629.35
D.Returns 1=Yield of Seed Cotton (1.5 Metric Tonnes per hectare in Non-Irrigated Areas and 2.5 Metric Tonnes per hectare in Irrigated Areas)*Seed Cotton Price (440 USD /Metric Tonne)	660.00	1100.00
E.Returns 2=Stalk Yield (3.0 Metric Tonne per hectare in Non-Irrigated Regions/ 3.5 Metric Tonne per hectare in Irrigated Regions*Stalk Yield Price (5.5 USD/Metric Tonne)	16.50	8.25
F. Gross Monetary Returns (D+E)	676.50	1108.25
G.Net Monetary Returns (F-C)	232.31	478.90

Source: Planning Commission Report on Farmers Suicides (2006)

[64] These figures are taken from field stations of the Central Institute of Cotton Research, Nagpur, Maharashtra. These can be different from the figures in the actual field.

While the seed companies have noted the importance of irrigation, the MMB packages that were first released in Vidharbha in 2002 contained instructions, but these were in finely printed English which could not be understood by illiterate farmers (Planning Commission 2006).

Input Subsidies: The success of the Green Revolution was strongly predicated on the provision of input subsidies to rice and wheat farmers to maintain low input prices. According to Acharya (2001), farm input subsidies were introduced based on the recognition that even if the farmer has applied modern technology and has produced efficiently, he may be subject to losses by the market place and thus lose his enthusiasm about increasing production. The objective has been to increase production through low cost input subsidies, and to assure remunerative prices to farmers and to provide food grains to consumers at low prices through the PDS. While the central government has provided subsidies for fertilizers, the state governments have provided subsidies for irrigation and electricity (Gulati and Bathla 2002). The subsidies on fertilizers, irrigation and electricity form the bulk of subsidies to the farm sector (Acharya 2001), which has already been explained in Chapter 3. Table 5.2 shows the nature of subsidies that are available to the Indian farm sector. As evident from Table 5.2, subsidies, especially power subsidies, have been increasing heavily between 1980 and 1996 in the case of the Indian farm sector.

Table 5.2: Subsidies to the Indian Farm Sector (In Millions USD)

Years	Fertilizer	Electricity	Irrigation	Credit	Total	GDP	Percent of GDP
1980-81	5.96	7.56	9.64	11.49	34.64	944	3.67
1985-86	22.69	21.84	18.78	23.51	86.82	1,555	5.58
1990-91	51.69	107.64	45.38	44.16	248.87	3,004	8.29
1995-96	60.62	252.20	39.29	60.09	412.20	5,680	7.26

Source: Gulati and Sharma (2002)

Who gets these subsidies? Shetkari Sangathana member Vijai Jaywandhia claims, "Farmers in rainfed areas never got the kind of subsidies that farmers in irrigated areas of the Green Revolution obtained." What kinds of subsidies are available to farmers in rainfed areas such as Vidharbha? Have they been impacted due to so-called budget cuts during the economic reforms? This section explains.

According to Gulati and Bathla (2002), Maharashtra, where Vidharbha is located, gets a fairly high amount of subsidies in comparison to other Indian states. However, if the distributional aspects of subsidies are addressed, then these input subsidies have been largely directed towards water intensive crops such as sugarcane and Green Revolution crops like wheat and rice. This means that cotton farmers in Vidharbha get low subsidies compared to sugarcane or wheat farmers as the area under irrigation in Vidharbha is only 21.87% [65] Ashok Gulati, a close associate of Indian Prime Minister Manmohan Singh and now the head of the South Asia Program at the International Food Policy Research Institute suggests, "The subsidies on fertilizers, irrigation, electricity and credit lower the costs of those farmers who have access to canal water, power lines and bank loans" (Gulati, Hanson and Pursell 1990). As seen in Chapter 3, Vidharbha has low access to credit besides irrigation. Finally, as

[65] Examining each subsidy one by one, in case of the fertilizer subsidy, Gulati and Narayanan (2002) find that between the years 1981 and 2001, the share of farmers in the central government subsidy was 68% while the fertilizer industry obtained a share of 33%. The fertilizer subsidies are paid both to the domestic units and imported fertilizers. Power subsidies that are used for pumping groundwater are the largest state subsidy, which have been growing over the years because power supply to agriculture attracts a very low tariff and in many states is free (Gulati and Narayanan: 2002). In terms of irrigation, insufficient cost recovery has been the major problem. The farmers have never paid the full cost of canal irrigation. Further, the collection of irrigation charges for surface water has been low and overall loss amounts to 7% of the total Plan expenditures on all irrigation schemes. This inability of the state to recover irrigation dues has led to a growing revenue deficit such that irrigation itself is currently responsible for a third of a state's revenue deficit. The pricing of irrigation water has been such that it does not even cover the cost of operation and management (O and M) of the irrigation systems, despite the fact that the farmers' ability to pay for irrigation water has increased due to the adoption of the Green Revolution package. These problems in the irrigation sector such as non-recovery of dues, and their availability to irrigated farmers in a few places has allowed the subsidies to be contained to irrigated areas. These are not available to rainfed areas such as Vidharbha (Gulati and Narayanan: 2002).

Joshi and Little (1996) conclude, the input subsidies favor richer, irrigated farmers relative to poorer rainfed areas, richer farmers relative to poor farmers and capital intensive relative to labor intensive crops (edible oils and sugar relative to cotton). Consequently, farmers in Vidharbha do not enjoy similar subsidies as did the farmers of the Green Revolution.

Impact of Structural Adjustment Programs on Input Subsidies: The structural adjustment program (SAP) established after the economic reforms did call for a curtailing of agricultural subsidies, in particular, fertilizer subsidies (Ghosh and Chandrasekhar 2007). However, the subsidies continued to be strongly entrenched and did not decline. A similar fate awaited the power subsidies when power sector reforms began in 1991. These reforms called for opening up the power generation to private enterprise, unbundling of the State Electricity Boards into transmission and distribution and their corporatization and an increase in power tariffs. However, in practice, none of these measures was actually implemented because there was stiff opposition to their removal (Gulati and Bathla 2002). In any case, none of these subsidies was available to the farmers in rainfed areas or in Vidharbha.

Price Support Policies for Cotton Producers in Vidharbha: The compensation of higher subsidies to large farmers and those in irrigated areas can be in the form of higher procurement prices (Joshi and Little 1996). Stable and increasing procurement prices played a big role in creating profits for rice and wheat farmers.[66]

[66] When the Green Revolution technology was introduced in India, agricultural price policy was an important instrument in increasing agricultural productivity and providing rice and wheat farmers with profitable incomes (Acharya and Chaudhuri: 2004). The agricultural pricing policy in India comprises of allotting MSPs for 23 commodities administered by the central government under the CACP. The CACP was set up in 1984 to intervene in agricultural produce markets, which includes cotton (Acharya and Chaudhuri: 2004). In the case of cotton, unlike rice and wheat where the MSP is announced for two cotton varieties, namely H4 (long staple) and F414 (medium staple variety) (Planning Commission Report: 2006). The rest of the MSPs are announced by the Textile Commissioner on the basis of market differential, fiber quality parameters and ginning outturn (Indian Council of Agricultural Research: 2007).

Cotton is not as an important product for the food security of the nation as much as rice and wheat were, but it does form an important raw material component of the textile industry. The textile industry is the biggest employer after agriculture. The MSP of cotton is calculated on the basis of cost of production such that it provides a reasonable return to the farmer (Gulati, Bhide, Bhagat and Shroff 2006). Over a period of time and place, some of the costs of production, as has happened in the case of Vidharbha, have become disconnected from the MSPs of cotton.

Table 5.3 shows the difference between the actual costs of production in Vidharbha and the MSPs that the central government sets for the local varieties of cotton in 2006. According to Table 5.3, the cost of production of both varieties is higher than its minimum support prices.

The difference between the cost of cultivation and MSPs arises because the MSPs that are decided at the central level have not been tailored to suit the specific regional situations:

> Favorable/unfavorable agro-climatic situations amongst different states lead to a variation in per hectare yields. The per hectare yield in Maharashtra is less than in other states due to less irrigation and unfavorable agro-climatic conditions. This leads to higher costs of production.[67] Due to favorable agro-climatic conditions, per hectare yields of cotton are more in other states. Thus cost of production is conducive to these states. This adversely affects states such as Maharashtra who have unfavorable agro-climatic situation and higher costs of production. The Minimum Support Prices declared by the government does not cover the costs of production. (Joint Director, Agricultural Prices Cell, Maharashtra, cited in TISS 2006)

Some levels of government, but not others, have recognized this problem of a mismatch between government prices at the center and the state. According to Dr.

[67] If the yield is lower and the input costs per hectare are the same or higher, it would lead to a higher cost of production per metric tonne of yield.

Shailaja Sharma, Director, Commission of Agricultural Costs and Prices (CACP),[68] "Central government sets MSPs only after consulting with farmers organizations. Farmers organizations come and lobby at the CACP."[69]

Table 5.3: Production Costs and MSP of Two Cotton Varieties (2006)

	H6	NHH44
Inputs	Total Cost in USD/ Hectare	Total Cost in USD/Hectare
Seed	35.94	19.19
Manures	10.82	14.03
Fertilizers	19.28	23.08
Hired Human Labor	86.41	43.10
Machine	7.89	9.84
Bullock Pair	39.81	31.74
Irrigation Charges	2.41	0.03
Insecticides	13.84	16.66
Insurance	16.62	16.62
Incidental Charges	1.39	1.10
Rental Value of Land	56.81	39.96
Family Human Labor	45.58	42.42
Supervision Charges	27.33	22.66
Total Costs (Sum of above costs)	364.13	280.44
Yield (Metric Tonnes/Hectare)	0.818	0.666
Cost of Cultivation/Yield (USD/Metric Tonnes)	445.15	421.08
MSP (USD/Metric Tonnes)	416.67	360.00
Difference (MSP-Cost of Cultivation) USD/Metric Tonnes	-28.48	-61.08

Source: Information on prices and costs taken from IGIDR (2006)

[68] Commission of Agricultural Costs and Prices is a central government nodal organization that sets Minimum Support Prices for agricultural commodities at the level of the central government.

[69] Comment, Shailaja Sharma, Director, Commission of Agricultural Costs and Prices, National Commission of Farmers: Center for Science and Environment Workshop, August, 2006.

Public Distribution System and Food Subsidies: As Chapter 3 shows, another major policy intervention of the Green Revolution period was the creation of the public distribution system (PDS). The PDS is a price-cum-quantity-rationing-cum-subsidy program, which includes provision of cereals to consumers at reasonable prices as well as maintenance of a buffer stock of a required quantity for national food security (Acharya 2001). The fact that the maintenance costs of the PDS system are more than what the state spends on agriculture, rural development and flood control taken together (Ministry of Consumer Affairs, Food and Public Distribution 2002) makes this subsidy fairly large related to agriculture, which means that this subsidy money is unavailable for investment in rainfed areas such as Vidharbha.

Social Welfare Policies: During the latter part of the Green Revolution, a key role was played by many agricultural and rural development programs that supported those small and marginal farmers who were unable to adopt the technology in the first phase of the Green Revolution. These programs included employment generation schemes and small farmer assistance programs such as the small farmer development agency (SFDA), the marginal farmer and agricultural laborer assistance scheme (MFAL) and the drought prone assistance program (DPAP).[70] The programs can also be considered a form of subsidy although at a smaller scale than the input subsidies (Acharya 2001). As a result of these subsidies, the Green Revolution spread to further wheat and rice-growing areas in the 1980s and those hitherto excluded from the technology gains were able to access these gains. Even while rural poverty continues to be prominent, these agricultural and rural development programs have played a big role in rural poverty reduction apart from the role played by technology.[71] What kind

[70] For instance, the Small Farmers Development Agency provided better credit measures for small and marginal farmers, while the Drought Prone Assistance Program aims to minimize the adverse impacts of drought on productivity of land and livestock. See Frankel. *India's Political Economy 1947-2004: The Gradual Revolution.* New Delhi: Oxford University Press, 2005.

[71] This should not be taken to mean that rural poverty has been reduced satisfactorily.

of support existed for agricultural and rural development programs when the GM seeds were introduced in cotton areas? Did the structural adjustment program have an effect on these programs and their budget outlays?

Table 5.4 presents the relevant outlays[72] culled from Five Year Plans of the Planning Commission. As Table 5.4 indicates, while the percentage budget outlay on agricultural development and irrigation is reducing after 1992, there has been continued outlay on rural development and special area development programs.

Table 5.4: Budget Outlays on Agricultural and Rural Development

	Agriculture and Allied Sectors (Percent Of Total Budget)	Rural Development (Percent Of Total Budget)	Irrigation (Percent Of Total Budget)	Special Area Development programs (Percent Of Total Budget)
3th Plan (1965–69)	20.50			
4th Plan (1969–74)	17.10	1.80	6.80	
5th Plan (1974–79)	11.80		8.70	
6th Plan (1980–85)	5.70	5.04	12.40	0.50
7th Plan (1985–1990)	5.80	5.04	9.40	1.60
8th Plan (1992–1997)	5.20	7.00	7.50	1.60
9th Plan (1997–2002)	4.40	8.50	6.50	0.40
10th Plan (2002–2007)	3.80	8.00	6.80	1.40

Source: Planning Commission (Various)

Loan Waivers: Even while government investment in subsidies continues to be poor in rainfed areas, due to the agrarian crisis, the government has launched a number of relief packages in Vidharbha and other rainfed areas. In June 2006, to compensate the farmers in distressed districts of Maharashtra, the central government

[72] The four areas represented above pertain to budget expenditures on agriculture and rural development.

released a relief package of 833 million USD[73] for six districts in Vidharbha (Wikipedia: Anon). This package is comprised of removal of interest on all loans taken by farmers, an increased credit flow to rural banks, investment in 82 major and 442 minor irrigation projects, investment in drip irrigation, development of horticulture and the creation of seed replacement programs. In addition, high yielding milch cows were gifted to many families.

In 2006, after the implementation of the Vidharbha relief package, another package of 3.77 billion[74] USD was announced for alleviating the agrarian crisis in the states of Andhra Pradesh, Karnataka, Maharashtra and Kerela. This package entailed debt relief to farmers, interest waivers on loans, improved supply of institutional credit, assured irrigation facilities, watershed management, better extension and farming support, improved marketing facilities and subsidiary income opportunities through dairying (WordPress 2008). Very recently, the government also announced a loan waiver of 13.3 billion USD[75] to help alleviate farmer's indebtedness (Express India, March 2008) and the creation of the National Rainfed Areas Authority (NRAA) (Project Monitor 2009).

Fragmented Political Power of Farmer Movements

As the discussion on the Green Revolution in Chapter 3 shows, the "new farmer movements" were an important phenomenon that allowed farmers to continue to gain from the Green Revolution technology. What is the status of these movements and how strongly have they represented the cotton farmers' issues of remunerative prices or subsidies or social safety nets? Unlike the strength displayed by in 1980s by

[73] Rs. 3,750-crore= Rs. 37,500,000,000/45= 833,333,333 USD =833 million USD.

[74] Rs 17,000 crores= Rs 170,000,000,000/45= 3,777,777,777 USD=3.77 billion USD.

[75]Rs. 60,000 crore= Rs.600,000,000,000/45= 13,333,333,333 USD=13.3 billion USD.

these movements (see Chapter 3) in terms of bargaining with the central government for an increase in subsidies and prices of farm produce, the strength of these movements has waned considerably after the economic reforms in 1991.[76] An example are the efforts to create a national level organization, an all-India Bharatiya Kisan Union, between 1984 and 1989 that led to a major rally in Delhi at the Boat Club in which thousands of farmers participated (Byres 1982).[77] In 1989, the first ever national policy on agriculture was formulated. A Standing Committee on Agriculture was created in the Parliament led by Sharad Joshi of the Shetkari Sangathana. The state became committed to debt relief and remunerative prices (Omvedt 1998).

However, after 1991, with economic reforms and the era of coalition and unstable governments, the power of the farmer movement has been on the decline (Brass 1995). In consonance with Sen's (1992) prediction, the advent of liberal policies and cutbacks in flows from the government for agricultural development have weakened the sources of political patronage by which the rural elite are linked to the national government (Sen 1992). Furthermore, many former farmers now draw most of their income from trade, construction, transport and urban jobs. Only 2.2 % were members of registered farmers' unions, according to a situation assessment of farmers by the National Sample Survey Organization (NSSO) (Krishnaraj 2006). The movements no longer wield a strong voice for the farming community though they appear to represent them for getting into power (Krishnaraj 2006). Thereafter, instead of gathering together, some of these movements have allied with industrial bodies in Delhi (Federation of Farmers Association of Andhra Pradesh) and some with environmental movements (Karnataka Rajya Ryotha Sangha). Part of the Shetkari

[76] Interview, Jaideep Hardikar, Reporter, DNA, Nagpur, November, 2006 and Vijai Jaywandhia, Key member, Shetkari Sangathana, Wardha, Nagpur, November, 2006.

[77] Interview, Jaideep Hardikar, Reporter, DNA, Nagpur, Maharashtra, November, 2006.

Sangathana, represented by Sharad Joshi, has favored global free trade as advantageous to the peasantry, causing a rift in the movement itself (Author's observation 2006). Part of Shetkari Sangathana, represented by leaders such as Vijai Jaywandhia, has aligned with the environmental movement, led by the Delhi-based organizations of Suman Sahai and Vandana Shiva (Author's observation, July 2006).

Alliances have also been formed internationally, such as the Inter-continental Caravan in Europe where Karnataka Rajya Ryotha Sangha led by Nanjunadaswamy joined hands with European green and social justice activists in 2001. Here, they opposed neoliberal globalization and genetically modified crops at various venues such as the Nuffield Council of Bioethics in London (Croeser 2006). However, there were too many internal divisions and criticisms within the organization and with other farmer or environmental movements. A stronger voice in the agri-biotech debate has been that of a number of environmental movements, represented prominently by certain groups in Delhi as described in the section on introducing biotechnology. Powerful movements such as Shetkari Sangathana have lost their top leadership and political momentum, as leaders such as Sharad Joshi have joined the Parliament and diverted themselves to other causes.[78]

Environmental movements which cover issues right from biodiversity to soil degradation from agricultural technology have risen and entered the arena of farm issues. While this might mean greater democracy in agricultural policy making, as scholar Shiv Vishwanathan[79] puts it, the environmental movements do not have as strong a grassroots base[80] as the previous movements did. Neither do they possess the

[78] Interview, Damodar Ugade, Previous member, Shetkari Sangathana, Wardha, Nagpur, November, 2006

[79] Comment, Shiv Vishvanathan, Center for Study of Developing Societies (CSDS), Delhi, Interview, 2006

[80] Comments gathered in the field at Vidharbha Agricultural Department, Nagpur, Maharashtra

nature of bargaining power as the previous farmers movement did to negotiate with the government on issues such as farm prices. To some extent, farmer organizations such as the Federation of Farmers Association of Andhra Pradesh and Bharat Krishak Samaj based in Delhi, have lobbied the government for remunerative prices for agricultural products.[81] The limited nature of power these organizations exercised over state policies can be seen from the lack of attention at the level of the state regarding remunerative prices of farm commodities.

Other rural issues including employment and food are being pursued by Rights based movements such as the Right to Food Campaign[82] elsewhere in the country. Much work has been done by these groups to bring about and implement the Right to Information Act that allows a citizen to track the implementation of rural development measures. Important contributions in successful implementation of welfare schemes have also been made such as the National Rural Employment Guarantee Act,[83] the Integrated Child Development Scheme (ICDS) and the Mid-Day Meal Scheme.[84] However, these groups have remained distanced from the farmer movements[85] and do not engage in lobbying for remunerative farm prices or better access to credit which have been the bastion of the so-called new farmer movements.

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[81] Krishan Bir Singh of Bharat Krishak Samaj operates a listserv at: indiansocietyag@gmail.com. The Federation of Farmers Association has an office at Federation of Indian Chambers of Commerce and Industry.

[82] Right to Food Campaign materials are available at: http://www.righttofoodindia.org/

[83] Jean Dreze, co-author of Amartya Sen, has been instrumental in the implementation of this act. Interview, Devika Lal, Member, Right to Food Campaign, Delhi, January, 2006.

[84] Jean Dreze has teamed with activist and former Indian Administrative Services (IAS) officer Aruna Roy to spearhead the Right to Food Campaign specially focusing on nutrition for children under six and through the better implementation of ICDS and Mid Day Meal scheme.

[85] Author's observation in the Rights to Food meeting on April 2006 near Parliament Street called by Aruna Roy, and attended by Jean Dreze and Sukhdeo Thorat where a new study of evaluation of ICDS and Mid Day Meal scheme was launched to ensure nutrition for children under six. No member of the farmer movement was present there.

The Left parties, such as the Communist Party of India (Marxist) raise issues relating to agricultural prices or subsidies, but they cover a wide range of issues such as inflation or price hikes in essential commodities that are of interest to both the rural and urban poor. This representation leads to the issues of cotton farmers not occupying as important a platform as they would if represented individually. Thus, cotton farmers who were not represented per se by the previous farmer movements have lost further representation during the era of economic reforms, which is the reason that it was only after public interest litigations and studies by governmental institutes such as Tata Institute of Social Sciences and the Indira Gandhi Institute of Development Research (see Chapter 4 for report citations) that the problem of poor economic returns to cotton farmers came to public attention. This is not to say that the farmer movement does not have any power in the Indian polity. The fact that the government accorded a loan waiver to Vidharbha shows that the farmer movement does have some degree of power vis-à-vis the Indian state.

Creating and Diffusing the Gains from the Green Revolution

Gains from technology were possible during the Green Revolution when technology was implemented along with profit making mechanisms and safety nets such as guaranteed support prices, irrigation, crop insurance and minimum support prices. The vast scientific enterprise of the Indian state ensured that the high yielding varieties introduced were tailored to different agronomic circumstances and produced results in the field. Given that increasing productivity of food grains was a national objective, implementation details were taken care of by the state through a vast network of national and local research and agricultural extension institutions. These extension mechanisms are critical to ensuring "certain" productivity and profits for farmers. However, in the case of the adoption of Bt cotton, most of these policy and

institutional measures are scarce, especially in rainfed areas such as Vidharbha. At a national level, no comprehensive biotechnology policy that linked the new technology with farmers' welfare was present at the time of the introduction of Bt seeds. The seed pricing was biased in favor of the seed companies, especially Monsanto, which made profits regardless of whether the seeds worked in the field or not.

The state did intervene after four seasons of introducing the new seeds, but the lack of a policy framework made it difficult for immediate action until there was a crisis. The nature of technology development shows that seeds will continue to be expensive unless the government takes stringent action to reduce seed prices. In regard to extension mechanisms, the private sector in Vidharbha provided limited coverage, and this stands in stark contrast to the extensive demonstration programs offered during the Green Revolution. The lack of supportive public policy and extension mechanisms was also evident in regulating the presence of the biosafety refuge and making genuine seeds available to farmers which had the Bt trait to eliminate the need to spray pesticides.

The fact that use of Bt cotton still necessitates some pesticide spraying makes the presence of a farmer-centric extension program even more crucial. However, there was a consistent vacuum in this sphere of public policy for technology dissemination, and that makes farmers' gains uncertain. Rainfed areas have not received the kind of extensive input subsidies that were provided to irrigated areas because the availability of fertilizers, electricity and, to an extent, credit subsidies are tied to the presence of water. While these subsidies have not been reduced due to economic reforms, they continue to be unavailable in rainfed areas. Policies such as MSPs that were introduced during the Green Revolution as an incentive for technology adoption and making farming remunerative have not worked for the cotton farmers of Vidharbha. Over a period of time, production costs have risen and MSPs have failed to match the

costs, leading farmers in Vidharbha and other cotton areas into indebtedness. The government has recently given some attention to the farmers' distress in Vidharbha and other rainfed areas through relief packages and loan waivers. Furthermore, there is no existing public policy that makes a party liable in case of the failure of Bt seeds. State regulations that could provide a safety net in case of poor performance were never part of the scheme in the introduction of GM crops. Given that 65% of cotton is grown under rainfed conditions, serious problems can result.

It is strange since the government itself realizes the problem. For instance, the approach paper to the 11th Five Year Plan states,

> As farmers adopt new and untried technology, and increase input intensities, they also face larger risks. These risks are often not well understood owing to lack of knowledge of the specific requirements of new seeds and other new technology for achieving productivity gains. All farmers do not have the ability to bear downside risks and this is evident from the spate of farmer suicides when new seeds fail to deliver expected output, or expenditure on bore wells proves infructuous, or when market prices collapse unexpectedly. (Planning Commission 2006b)

The government has made crop insurance available, but this is restricted to only 4% of areas across India. In the case of Bt seeds, the intellectual property rights have been so structured that the seed companies do not have any liability in case the seeds fail to work, but its profits are certain because the seeds have already been bought by farmers and sown. Finally, the bargaining power of the farmer movements that arose during the Green Revolution does not appear to exist in the case of the Gene Revolution, which is the reason that measures such as crop insurance or minimum support prices have not been instituted by the government.

Chapter 6

INTERNATIONAL TRADE POLICY AND COTTON FARMERS

The removal of the global MultiFiber Agreement (MFA)[1] in 1995 expanded the possibilities of textile exports of developing countries to the global market that were hitherto restricted by developed country quotas. In anticipation of these opportunities, the Indian government provided incentives to the textile industry as part of the 1991 economic reforms program. These incentives included de-licensing of the cotton textile industry, de-reservation of the textile sector, removal of export barriers, and slashed import duties for raw cotton for textile exporters. Similar incentives were not provided to the cotton producers.

With the removal of MFA, the demand structure of the domestic textile industry is changing towards the use of extra long staple cotton (ELS). The removal of import duties for raw cotton in India and the influx of foreign cotton in 1998 either makes the cotton producers' situation precarious or does not allow them to make any gains from the new opportunities that expanded global trade provides. Under what international policy and institutional conditions has Bt cotton been adopted? How does the international policy and institutional environment affect the livelihood of cotton farmers? This chapter elucidates on the situation.

Open Markets, International Subsidies and Cotton Prices

Cotton is an important commercial crop that is consumed by the textile industry (Roy 1996). India's cotton textile industry is the largest segment of organized industries in the country. The importance of raw cotton is different from rice and

[1] A global agreement that contains restrictive quotas for exports of textiles from the developing to developing countries that has been in place since 1970.

wheat whose relevance was directly related to the food security of the nation when India was a food scarce nation in the 1960s. India earns an annual foreign exchange of USD 10–12 billion from exports of raw cotton, cotton yarn, thread, fabrics and apparels (Singhal 2003). In 2000 and 2001, the textile and garment industries accounted for about 4% of GDP, 14% of industrial output, 18% of industrial employment and 27% of export earnings (Landes, McDonald, Singh and Vollrath 2005).

Textile industries are the largest employer segment after agriculture in India. The textile industry accounts for about 81% of the total fiber consumption in the spinning mills and about 66% of the total fiber consumption in the textile sector (Ministry of Textiles 2005–2006). In terms of area, cotton accounts for nearly 4.6% of India's agricultural area, which is the highest amongst cash crops and follows major cereals such as rice (23%), wheat (14%), jowar (coarse millet) (9%) and bajra (another coarse millet) (6%) (Gulati, Hanson and Pursell 1996).

India produces a wide range of cotton varieties, which are grouped into five categories on the basis of staple length: short staple (19mm), medium staple (20–21.5 mm), medium long (22–24mm), long staple (24.5–26 mm) and extra long staple (above 27 mm) (Gulati, Hanson and Pursell 1996). The share of short staple is 6.33%. The share of medium and medium long staple is 45.89%, and the share of long and extra long staple variety was 47.78% in 1997–98 (Ministry of Textiles 2005–2006).[2] The South Zone (Andhra Pradesh, Karnataka, Tamil Nadu) produces mostly long staple and extra long staple cotton, the North Zone (Punjab, Haryana, Rajasthan) produces short and medium staple, and the Central Zone (Maharashtra, Gujarat, Madhya Pradesh) produces a range of medium and long staple varieties (USDA 2005).

[2] 6.33+45.89+47.78= 100

India, unlike African countries such as Burkina Faso that only exports raw cotton, intervenes in all segments of the cotton commodity chain. This includes production of raw cotton; cotton ginning and processing; processing of cotton yarns; weaving and finishing of yarns; creation of grey cloth; and creation of apparels and readymade garments.[3] What is the relationship between the textile industry and cotton production and how does it dictate the kind of support and incentives that are available to cotton producers?

Domestic Policies for Export-Import of Cotton

India both exports and imports raw cotton, although in 1998 India became a significant importer of cotton (Landes, Macdonald, Singh and Vollrath 2005). While India does export raw cotton, its volume is not as high as that of the United States and China, which account for 20% of the world's output each, followed by India (12%) (Baffes 2004). However, India is known more for its textile exports rather than its raw cotton exports.

According to Gulati, Hanson and Pursell (1990), the policies relating to cotton exports and imports have evolved in accordance with the interests of the textile industry. Gulati, Hanson and Pursell (1990) note that since cotton forms an important crop for the textile industry, its domestic price has been held lower than its international price. The exports of raw cotton are allowed only if the needs of the domestic industry have been met even when world prices have been higher than domestic prices. Table 6.1 shows the difference between these prices and the nature of subsidies available for the cotton textile industries between 1982 and 1995. As evident from Table 6.1, cotton production has been consistently higher than mill consumption.

[3] Interview, Bhagirath Chaudhury, ISAAA, Pusa Institute, Delhi, November, 2006.

However, domestic prices of cotton have been consistently lower than international prices, which becomes a subsidy to the textile sector.

Table 6.1: Nature of Subsidies for Cotton Textile Industries (1982–1998)

	Production of Cotton (Million Metric Tonnes)	Mill Consumption (Million Metric Tonnes)	Domestic Price (USD per Metric Tonne)	International Price (USD per Metric Tonne)	Subsidy to Mills (USD per Metric Tonne)[4]
1982-83	1.39[5]	1.28	1.18	1.48	0.30
1985-86	1.61	1.43	1.26	1.97	0.71
1988-89	1.65	1.62	1.75	2.15	0.40
1991-91	2.11	1.79	2.38	3.40	1.02
1994-95	2.26	1.96	4.04	4.68	0.63

Source: NCAER (2001)

Gulati, Hanson and Pursell (1990) note that cotton is subject to annual export quotas, with public sector agencies such as the Cotton Corporation of India (CCI)[6] taking up the bulk of the quotas. While these quotas shielded the cotton producers from the vagaries of the international market prices, they tended to suppress domestic cotton prices by restricting exports (Landes, McDonald, Singh and Vollrath 2005).

The government has also given other incentives to the textile industry. The new textile policy of 1985 led to the modernization and technological upgrading of the textile sector. The policy undertook a number of measures such as raising maximum limits on investments, reducing import controls and tariffs, promoting apparel and textile exports through "duty-drawback programs" and creating export promotion organizations such as the Apparel Export Promotion Council and Textile Export

[4] Subsidy to mills=International Price-Domestic Price

[5] The earlier version of the table contained production in bales. This has been converted to metric tonnes. One bale=170 Kgs. 1 kg= 1000 metric tones.

[6] The Cotton Corporation of India was created to stabilize prices, regulate imports, and supply raw material to the public sector textile mills.

Promotion Council (Tiwari 2006). This integrating trend of the national textile industry with global markets was strengthened during the 1990s' economic reforms which assisted the continuation of export promotion measures for the textile industry through the establishment of the Technology Upgradation Fund Scheme (TUFS) in 1999. This provided further incentives towards increasing clothing and textile exports (ExpressTextile 2006).

At the CSE-NCF Roundtable (July, 2006) held to discuss farmer suicides, M. S. Swaminathan noted, "Cotton textiles do well, but cotton farmers do not. There is something wrong with the economics of cotton production." While protection and subsidies have been accorded to the cotton textile industry, similar kinds of protection or subsidies have not been available to the cotton farmers. In order to protect the cotton farmers, an import duty on raw cotton was in operation until 1991. However, post economic reforms, cotton exports and imports were placed under an open general license (OGL) scheme, which was done to make the textile industry competitive in the international market (Ministry of Textiles 2007–2008). Placing cotton under the OGL led to the creation of zero import duties on raw cotton. The Cotton Corporation of India (CCI) was no longer a monopoly importer and Indian cotton traders and the textile industry were allowed to import cotton of any variety freely from any country to meet their requirements.

As a consequence, between 1998 and 2002, India witnessed an increase in the imports of raw cotton, for international prices were lower than domestic prices (Ministry of Textiles 2007–2008). Worldwide, cotton prices have been declining since 1995 (Sengupta 2003). These declining price trends are to the result of the increasing subsidies on raw cotton provided by developed countries such as the United States and China to their farmers. Table 6.2 shows the subsidies available to farmers in major countries.

Table 6.2: Cotton Subsidies to Farmers by Major Countries

	Assistance (Million USD)	
Country	1999–2000	2001–2002
USA	2,065	2,300
China	1,534	1,200
EU	844	700

Source: ODI (2004)

Subsidies from developed countries lead to an overproduction of cotton in the country and its dumping into the international cotton market. The dumping lowers the international price of cotton and eliminates the comparative advantage of small cotton producers in many developing countries where the cost of production is much lower than that of the developed countries. Due to cotton being placed under the OGL and the domestic market being opened to foreign competition, Indian cotton lost its competitiveness in a declining international price scenario (Ministry of Textiles 2007–2008). During the last five years, cotton prices have actually declined, thereby compounding income losses for farmers. The unfavorable price trends for these crops are the result of liberalization of agricultural product imports, to a large degree. Unlike other crops, cotton did not have the benefit of tariff protection against imports from other countries (Vaidyanathan 2006).

The import duty of cotton was increased from 0 to 10% in 2002 in order to stop the cheaper imports of foreign cotton (Ministry of Textiles 2007–2008). However, India's import duties for cotton continue to be much lower than countries such as China or the United States, and this can further affect the prices of cotton. India could also protect its cotton farmers through an increase in import duties from 10% to 40%. In practice, the import duty cannot be raised, for this will negatively affect India's exports of cotton yarn and cotton textiles (Singhal 2003). The increase in textile and clothing exports rests on the availability of cheap international cotton which the textile industry can access due to the reduced import duties. Textiles and

clothing are major areas where developing countries such as India stand to gain the most in the new global market.

Removal of the MultiFiber Agreement and the Indian Cotton Textile Industry

Another reason for the rise in cotton imports over the past few years is the need for extra long staple (ELS) cotton used primarily for fine fabrics and clothing, which links to a larger question of the changing demands of the textile industry, which is now being linked to a global textile market. Domestic production of ELS amounts to 68,000 metric tonnes per year, whereas the requirement is 153,000–204,000 metric tones: a figure that is bound to rise. Also, Indian ELS is not of good quality due to contamination. The varieties of ELS cotton imported were U.S. PIMA and Egyptian cotton. The U.S. sells its cotton at extremely low prices (CSE 2006). Increased import demand has been associated with a combination of steady growth in domestic consumption and rising exports of cotton-based textiles between 1997 and 2002 (Landes, McDonald, Singh and Vollrath 2005). Globally, since 1998, India has accounted for 6% of the total world imports of raw cotton (Mohanty, Fang and Chaudhury 2002). Nearly 5% of these imports have come from the United States.

The share of cotton imports is currently small but might rise with an increase in textile industry demand for apparel exports, which require higher quality extra long staple cotton. For instance, P.T. Patodia, President of the Confederation of Cotton Textile Industry, an important policy body, noted,

> Most of the new cotton hybrids developed by the private seed companies as well as public sector cotton research institutes fall in the category of medium staple cotton. It was, therefore, felt that in the coming few years, the country may face a situation of shortage in the category of extra long staple, long staple and short staple cotton. It may, therefore, be appropriate that immediate measures are taken to develop new varieties which are high yielding and which meet the quality parameters of the industry, in these staple length groups. (Patodia 2006)

Besides deepening liberalization trends of national textile policies, international dynamics such as the removal of the MFA currently shape the relationship between cotton producers and the textile industry. The MFA has regulated the international textile and clothing trade since the 1970s. The regulations were used by the United States, Canada and European countries to impose quantitative limits on imports of a wide variety of textile products from developing countries to protect their own firms. The MFA quotas were the most restrictive in clothing, particularly cotton clothing, and this led to significant distortions in trade opportunities for textile and clothing exports from developing countries (Tiwari 2006).

India's share of textile and apparel exports has recently experienced growth. India's share of textile exports has increased from 2.4% to 4% and clothing from 1.7% to 2.8% of the world share between 1980 and 2005. This might seem like a small change, but it is impressive growth considering the persistence of many factors that have shackled productivity growth in the textile and clothing sector such as technological obsolescence, fragmented capacities and low scales of operation (Tiwari 2006). Post MFA, India and China's export share of textiles and clothing to the global market is expected to increase to 23% and 65% (Nordas 2004). With the removal of quotas, large developing countries with stable supply and networks and well-developed capacities for scaling-up, such as China and India, will and have benefited from the elimination of textile quotas in the changed global market for textiles and apparel (Tiwari 2006). It was only because of the above-mentioned prospect of gains that developing countries could make from the liberalization of textiles and clothing sector that developing countries agreed to include services and intellectual property rights in the international trade negotiations (Nordas 2004).

The new and expanding export-based industry requires a number of qualities in the cotton than those required for domestic textile and clothing production. These qualities

are, namely, cleanliness or lack of contamination of cotton fibers, consistency of fiber quality, and long staple fibers. Indian cotton fares poorly on these fronts. Indian cotton, which is picked manually,[7] is poor in consistency and quality because it is contaminated with jute and other fibers and there is a presence of different varieties of cotton together in cotton bales. Thus, imported cotton is often used to produce a number of items destined for the export market. Despite the fact that a wide variety of cotton types are produced in India, India does not produce enough ELS cotton required for high quality clothing production (Landes, McDonald, Singh and Vollrath 2005). Neither does the cotton produced in India meet the cleanliness standards that are required for international clothing production. Currently, the imports of extra long staple cotton are 6% of the total share of cotton imported (CSE 2006). However, with an increase in textile and clothing exports, the demand for such quality cotton is expected to grow. The experience of 1998, when there was an influx of U.S. cotton in India's domestic market, highlights the importance of this fact. The risk associated with the unreliable quality of domestic cotton leads some textile producers to prefer imported cotton to meet export orders that demand consistent quality. The increasing importance of quality cotton can lead to an increase in greater imports unless there is parallel increase in quality cotton grown domestically (Landes, McDonald, Singh and Vollrath 2005). While this might not affect cotton growers in Vidharbha directly, it will affect other cotton growers, and the cotton growers of Vidharbha do not benefit from this open market in any way.

Price, besides quality, is another consideration of the cotton importers and export oriented textile firms in purchasing imported versus domestic cotton. Economic factors such as more favorable credit and contracting terms for imported cotton and

[7] The fact that Indian cotton is manually picked is not only an asset of Indian cotton, making it very fine, but it also turns out to be a liability affecting the quality and consistency of cotton.

liberal policies towards imports are added factors in the use of imported cotton by export-oriented mills. Imported cotton is typically purchased with 3–6 months of supplier credit, compared with 15–30 days of credit for domestic cotton (Landes, McDonald, Singh and Vollrath 2005). Recognition is rising in the textile industry that domestic production might not be able to meet the needs of the growing export sector (Landes, McDonald, Singh and Vollrath 2005). Another big factor that can affect export demand and supply of cotton is the timing and pace of the supply of exports required by the restructured global textile market. After dissolution of MFA quotas, the emergence of new considerations such as fast replenishment and short turn-around times for time sensitive and quick selling items like jeans and T-shirts is altering the sourcing of textiles (Tiwari 2005). The use of information technologies for these fast delivery items and the rise of lean retailing lead to a privileging of speedy delivery rather than cheaper prices of fine textiles. Market access is dependent on the ability of the local supplier to meet increasingly stringent buyer demands for quality, customization and packaged supply, which could have a significant impact on the timely availability of desired quality of cotton that the domestic market is unable to fulfill.

The need to meet the changing demands of the textile and clothing industry has also not been addressed in the new genetically modified varieties. Instead of making an investment in the varieties that can suit the needs of the changing textile market, the Bt gene has been introduced in the varieties that existed before.[8]

Adverse Impacts of International Trade Policy on Cotton Farmers

Even though GM cotton might lead to an increase in productivity, cotton farmers in the current international economic scenario will not be able to get good

[8] Interview, Bhagirath Chaudhury, ISAAA, Pusa Institute, Delhi, November, 2006.

prices for their product because government policy is biased towards the cotton textile industry. The state, after liberalization, has protected the interests of the textile industry and refused to increase the import duty of cotton. Even though the share of cotton imports is currently small, it might grow in the future with the changing needs of the textile and clothing industry, which is affecting and will continue to affect domestic cotton prices.The Vidharbha farmers already face higher production costs than the minimum support prices.

Chapter 7

CONCLUSION: A POLICY INTERVENTION

A Biotechnology of the Poor?

The GM debate is very narrowly focused on the role of technology in either decreasing poverty, protecting the environment or the negative effects of technology on the environment. Further, the analyses are either very place specific, global or quantitative in nature, with a lack of appropriate understanding towards the social and political contexts in which GM technology is being introduced. Contexts and conditions are important in shaping the effects that technology will have on farming communities. The literature on the Green Revolution highlights the importance of three critical contextual factors in understanding the benefits and risks of GM crops:

- Economic and ecological conditions of farmers adopting new technology
- Presence of supportive policy and institutional infrastructure
- Agency and bargaining power of the new farmer movements.

Tracing the presence of the above-mentioned factors to understand the nature of gains that cotton farmers in Vidharbha might make from new technology, Table 7.1 summarizes the adoption conditions of GM cotton in Vidharbha in a comparative framework with the adoption of Green Revolution seeds in rice and wheat regions in the 1960s.

Table 7.1: Comparing the Adoption of HYV Seeds with GM Seeds

Factors	Sub-Factors	HYV Seeds	GM Seeds
1) Farmer conditions	Ecological economic	Irrigated. Materially wealthy, well connected to informational networks.	Lack of water. Indebtedness. Developmentally backward regions. Lack of information or connections to bureaucracy
2) Policy and institutional support	State policy towards farmers	Clear policy. Food security as important as security of the nation. Increasing production top imperative. Making farming "safe and remunerative" so that farmers can invest in farming	Unclear policy. Agriculture no longer a critical sector.
	Seed prices	Subsidized by government	Extremely high
	Presence of irrigation	Available in Green Revolution areas. Power subsidies allowed irrigation particularly through tubewells to expand in areas where there was no irrigation.	Not available
	Input subsidies (fertilizers, electricity, irrigation, credit)	Input subsidies mostly available in irrigated areas.	Very low in rainfed areas. Input subsidies tied to the availability of water
	Commodity prices	Favorable prices for rice and wheat producers.	Biased towards the textile industry. Cotton prices. Lower than the international prices.

Table 7.1 (Continued)

Factors	Sub-Factors	HYV Seeds	GM Seeds
	Procurement	Rice and wheat brought by government at favorable rates	Marketing mostly left to private trade. In the case of Vidharbha, state intervention
	Credit availability	High in irrigated areas	Thin in rainfed areas and Vidharbha
3) Agency of farmer movement	Bargaining power of farmer movement	Strong. Representation in Commission of Agricultural Costs and Prices. Fertilizer subsidies retained	Weak bargaining power. Farmer's movement allied with the environmental movement and media to get loan waiver for Vidharbha. Still no social safety nets or MSPs to match production costs

Source: Author

Given the above situation, it appears that the potential gains from cotton farmers in Vidharbha are fraught with uncertainties. It is highly unlikely that farmers will make "certain" gains, even if the adoption of GM crops leads to greater productivity per unit of land. Can relief packages such as those given to Vidharbha compensate in terms of state support? Interviewees in Vidharbha suggest that the government relief package will only be able to meet the Vidharbha farmers' immediate survival needs.[1] The money allotted for irrigation will only be useful in the next 3–5 years which is the time taken for irrigation projects to get operationalised. Provisions such as cows would be unaffordable by poor farmers who do not have space or fodder to keep them. The package did not help those farmers who have taken loans from non-institutional sources or waive the actual loans that have placed farmers

[1] Interview, Jaideep Hardikar, DNA Reporter, July, 2006 and Interview, Kishore Tiwari, Activist, Nagpur, July, 2006.

into deep debt.[2] Not much attention has been paid to developing rural infrastructure in the region (Narayanmoorthy 2006). A loan waiver proposed by the Central Government in 2008–2009 budget of 13.3 billion USD waives all loans taken by small and marginal farmers (0.01–2 hectares) from institutional sources (Business Standard, November 2009). This loan waiver waives loans taken from institutional sources which amount to 1,333 USD.[3] However, such a scheme will mostly benefit farmers who are able to take loans from the government commercial banks. Almost 50% of the total rural debt is from non-institutional sources, wherein the majority of small farmers are dependent on moneylenders. These farmers are not addressed in this package.

Secondly, the loan waiver is based on the size of the land and not other parameters which affect the real income of the farmers such as soil quality, nature of crop production, irrigation availability and crop prices (Narayanmoorthy 2006). Many farmers in dryland areas have landholdings above 2 hectares in size that are unproductive. Further, many poor farmers have taken small loan amounts such as 89 USD.[4] These farmers will not get much benefit from this scheme. There are several farmers who could belong to the category of small farmers who own more than 2 hectares of land but who are distressed because of a mismatch between crop production and minimum support prices. These are not covered by the new loan waiver arrangement. However, public policy has highlighted the development of agricultural biotechnology as a critical tool for development of drought prone areas (Planning Commission 2006). A sequential question then arises: Will cotton farmers in Vidharbha and other rainfed areas make gains from GM crops in the future?

[2] Interview, Vijai Jaywandhia, Shetkari Sangathana, Wardha, Maharashtra, July 2006.

[3] Rs. 60,000= Rs 60,000/45=1,333.33 USD.

[4] Rs. 4,000= Rs. 4,000/45=89 USD.

Future Development of GM Crops

As Chapter 6 indicates, the nature of competition in the GM cotton seed industry is such that given the high production costs of GM crops, the future development of the GM seed industry will be driven by big private sector players. The crops grown in dryland areas of India are open-pollinated rice and wheat and self-pollinated grains such as chickpeas, pigeon peas, mung beans, groundnuts and soya beans (Ramaswami and Pray 2007). Currently, the GM crops that are in the Indian market besides GM cotton are GM mustard and Bt eggplant. Bt rice was also being developed by the private sector, but has not yet been commercialized.[5] According to the seed industry's academic experts, the crops that are being grown in dryland areas are not of much interest to private sector actors because the plant breeders' rights do not extend to seeds saved or exchanged as is the case with open-pollinated varieties (Ramaswami and Pray 2007).

Monsanto has claimed that it is working on a new generation of crops that are drought-resistant, suggesting that it has transferred these genes into corn, soya bean and cotton in the United States (Business Standard, 27 March 2007). It is possible that this technology might also enter countries such as India. However, looking at the overall scenario of GM crop production in India and abroad, the GM seed industry research is focused on the production of crops that are not grown in rainfed and dryland areas. The public sector, as the case of Bt shows, does not have the financial or the technical resources to develop such biotechnology products, despite repeated claims that they have developed them. Any public-private partnership to develop such products is yet to materialize. Even if these varieties do get produced, if the government fails to put in appropriate price controls on seeds, the high costs of these

[5] Interview, Bhagirath Chaudhury, ISAAA, Pusa Institute, Delhi, July. 2006.

GM crops will be borne by farmers unless the seeds are purchased by the public sector. In rainfed areas where there is a high uncertainty of rainfall, poor irrigation development, and poor economic remuneration and political representation, it is unlikely that GM crops will lead to certain gains.

Developing Policy Alternatives

Can Bt cotton or GM technology then ever be useful for farmers in Vidharbha or other rainfed regions? What might make Bt cotton and GM crops useful for farmers in such areas? If GM crops are rejected, then should farmers continue to farm traditional cotton crops or should they switch to food crops? Should organic farming be adopted? A last alternative could be to completely eliminate cotton production and switch to non-farming alternatives. What kind of policy supports are needed in order to adopt any of these alternatives? The section below presents five strategies that can solve the Vidharbha crisis. While these strategies have been presented exclusively, they overlap each other. On the other hand, the strategies can be used separately, and measures that are written as part of Strategy 1 can be used as a part of other strategies.

Strategy 1: Continuing to use Bt cotton: Bt cotton can be useful for farmers only if several criteria are met such as affordability of seed, appropriateness for local conditions, presence of low cost water harvesting systems, presence of quality regulation of seeds, precision-based extension systems, access to credit, presence of marketing cooperatives and crop insurance.

Pricing Technology: Bt varieties are expensive because Bt technology is privately owned under a monopoly by Monsanto. Sufficient competition does not exist between the indigenous companies and the international company to lower the price of the gene in the private sector. The government has already turned down the opportunity to buy Bt technology from Monsanto. There is a need to develop Bt

technology in the public sector and then insert it into a number of varieties, both hybrids and non-hybrid (open) ones.[6] It is also important to test the biosafety of these crops on a cost effective basis (as the current biosafety tests are expensive). This would help tremendously in bringing down the total cost of the seeds. Moreover, it would restrain the development of the spurious seed market to some extent to which the high cost branded seeds have given rise which the government has found difficult to regulate. In the case of cotton, since good germplasm is held by the public sector,[7] the development of a number of Bt cotton varieties is likely to take the form of a public-private partnership. However, if the Bt gene is developed in the public domain, the cost of the varieties would be even lower than the present costs. In the event that the public sector is unable to develop Bt technology or other GM crop technologies on its own, it could either buy these technologies from another public sector institute (say China) or collaborate on a regional basis with other public sector institutions to develop required varieties (Pingali and Traxler 2002).

Quality Regulation, Precision Pesticide Management and Extension Programs*:* Failure to test and regulate the presence of the Bt trait in the varieties released (so that the variety that farmers buy has the trait and hence the guarantee of productivity), has led to uncertain returns for cotton farmers in Vidharbha. Bt cotton could work if local agricultural universities and extension departments could match different varieties to field conditions and monitor the expression of the Bt gene in those field conditions, and this would again mean investment of funds by the public

[6] The government has recognized the need for introducing the Bt technology in publicly held open varieties, which are much cheaper. This was addressed at the CSE-NCF Roundtable Conference, held at the National Academy of Agricultural Sciences, Delhi on June, 2006. It was chaired by M.S. Swaminathan. At this conference, premier members of the environmental and development community were present, including Sunita Narain (CSE), R.B. Singh (NCF), Monsanto, Vijai Jaywandhia (Shetkari Sangathana) and Bhagirath Chaudhury (ISAAA).

[7] Interview, Harish Damodaran, Associate Editor, HinduBusinessline, Delhi, April, 2008.

sector to develop the capacity of local agricultural bodies. Given that the seeds are so profitable for the private sector, and the private sector is the major agency producing these seeds, it would also be efficient if the private sector undertakes some of these extension arrangements.

A testing kit has been developed by the CICR to check for the presence of the Bt trait. This kit should be made available to farmers or local institutions at a low cost, so that they can check for the presence of the gene themselves. Besides the Bt trait, the quality of hybrid seeds that have been released even before Monsanto came into the picture (see Chapter 4 on Vidharbha) also needs to be regulated. A similar mechanism to the one used by the Central Varietal Release Committee that monitors and certifies public seeds needs to be put in place for the private sector as well.

Given that there is still a need for pesticide application despite the use of Bt cotton, government agricultural agencies or private sector actors need to develop programs for precision pesticide application to Bt cotton under diverse agronomic conditions. The farmers need to be trained in using such programs. Local agricultural extension networks could be involved as well as private seed agencies to conduct these training programs. To monitor the quality of pesticides and fertilizers, laboratories could be set up at the district or village level and periodic inspections by quality control inspectors could be undertaken.

Bt cotton only controls the American Bollworm. Sucking pests such as aphids, hoppers, and jassids which affect cotton plants in the earlier days of flowering are not controlled by Bt cotton, an increasing problem in many Bt areas. Stem application is a cost-effective method developed by scientists at Acharya NG Ranga Agricultural University, Andhra Pradesh. Systematic insecticides such as Methyl-Oxy demeton, Imidacloprid, mixed with water are used. This technique is especially useful for areas with water scarcity; moreover, the insecticide does not require too much skill in its

application (The Hindu, 6 July 2006). Another way could be to add additional genes in Bt cotton for controlling the secondary pests.

Better Minimum Support Prices for Cotton: A big problem for cotton farmers is the discrepancy between the cost of production and the MSPs that the government sets at the central level. Calculating the costs of production, however, is not a simple task. Costs of production differ according to regional agronomic conditions as well as the strength of marketing institutions that serve the farmers' interest. As the section of Chapter 4 on cotton marketing shows, corruption in the marketing scheme has led to incorrect grading and hence lower prices on cotton for farmers with weak bargaining power, so a need exists to develop institutions that would administer the prices at the field level besides correcting the MSPs. It is not very clear in the case of Vidharbha if the monopoly scheme will be reinstated and if so, when. Thus, as in the case of Maharashtra, the state needs to create certain measures to protect the farmers from the vagaries of private trade, which the farmers have been suddenly subjected to because of the removal of the monopoly procurement scheme.

Small Scale Irrigation Development: Water scarcity is affecting cotton production and is a major problem for cotton farmers and farmers in dryland rainfed areas. Given that large scale irrigation development cannot take place in these areas for geological reasons, alternative measures that are cost effective have to be found, such as small-scale irrigation development. According to Edward Coward (1988), small scale irrigation development depends on setting the technical process correctly: selecting the right structures to capture the water supply, proposing effective structures to water the agricultural area, and formulating appropriate technical rules for rotating the water supply. Measures such as drip irrigation could be useful.

Drip irrigation has been used in select areas in Maharashtra (Maharashtra has the highest area under drip irrigation) and especially in the case of horticulture and

vegetable crops. Here, water is supplied through a network of pipes at regular or intermittent intervals with the help of emitters. Supplying water straight to the crop roots reduces evaporation, and transmission losses. Thus, this process increases water use efficiency and decreases the cost of production. This system is suitable for undulating terrain and shallow soils (Narayanmoorthy 2004) and also could be implemented in the case of narrow spaced crops such as cotton. Drip irrigation systems have also been recognized and supported by the government. However, because the technology continues to be expensive, the capital costs of this technology need to be reduced (Raju, Narayanmoorthy, Gopakumar and Amarnath 2004). For improved adoption of the system, better information needs to be provided to farmers regarding the operation, maintenance and usefulness of drip irrigation measures and provision of subsidies (Narayanmoorthy 2004).

In the case of Vidharbha, more traditional water harvesting structures such as malguzari tanks (traditional tanks constructed in earthen embankments for harvesting water and irrigation purposes) are present (Planning Commission 2007). With appropriate physical rehabilitation and institutional development, many of these tanks and irrigation structures could be revived to relieve water scarcity. Furthermore, micro-finance measures could be used to develop rainwater harvesting measures. However, merely water harvesting, conservation and developing irrigation systems will not solve the entire problem because these are merely supply side measures. Watershed management programs that are already prevalent in India and that are being consolidated under the institutional authority of the National Rainfed Area Authority (NRAA) created in 2006 hold the key to the water conservation problem. While watershed management is being accomplished in parts of Maharashtra (IWMI and CRIDA 2006), there are not enough data to suggest that watershed management has been tried as a strategy for water conservation in Vidharbha, which could also be used.

Accessibility to Rural Credit Institutions: Credit is the mainstay of a robust agricultural economy. As Chapter 4 shows, credit availability is constrained in the economy of Vidharbha. Besides the fact that rural defaulters lead to a problematic rural credit availability, there are other problems with rural credit institutions such as high interest rates, and in general the lack of enough rural credit institutions to service the entire rural population. In order to make credit more accessible to rural households of all classes, there is a need to provide credit at an appropriate interest rate that makes the system accessible to small and marginal farmers. There is a need to simplify the procedure of obtaining loans from local rural banks and help should be extended to those farmers who are unable to read and write in going through the paper work that is required for obtaining loans.

While the Indian government has waived off the loans from institutional credit networks, they have not done so from moneylenders. Even if a one time loan waiver is given to the farmers to waive off loans taken from moneylenders, the money will only end up being used by the moneylender. The prime way out of this problem is to strengthen the rural banking system so that farmers have greater accessibility to institutional sources of credit.

Alternative credit arrangements need to be thought of, such as microfinance institutions, which have proven to be cost effective ways of credit delivery in Vidharbha and other rainfed areas. Microfinance institutions use innovative methods to reduce transactional costs, such as methods of screening and monitoring adjusted to local circumstances to reduce the costs of lending or the use of joint liability lending which makes several people responsible for an individual loan. Microfinance institutions like the Grameen Bank have been successful because of its disciplined practices of weekly public meetings, payment of loan installments, and collection of

savings (Johnson and Rogaly 1997). While micro-credit institutions should be promoted, they should not be considered in lieu of formal rural banking arrangements.

Crop Insurance: As Chapter 4 on Vidharbha makes it clear, crop insurance that can function as a risk insurance cover against environmental and economic uncertainties for farmers is needed in rainfed dryland areas. The National Agricultural Insurance Scheme (NAIS) and a pilot project on weather based insurance are already in operation in parts of India (although they cover about only 4% of the area) (Planning Commission 2009). The 2008–09 Union budget has given increased funding for extending the NAIS and for implementing the pilot project on weather based insurance (Budget 2009). It would be easy to extend this scheme to all areas but there is a reason that this has not happened until recently because the costs of extending this scheme to all the areas would be very high. Cost effective ways of extending crop insurance measures, while potentially linking them with micro-finance institutions need to be devised.

As Chapter 4 on Vidharbha indicates, there are problems involved in estimating yields while providing crop insurance due to the poor estimation practices of corrupt local patwaris (keeper of village land records). Thus, better supervisory practices should be devised that allow the extension of crop insurance to needy families, especially when they are illiterate. Crop insurance measures should provide paid compensation for farmers in case of crop failure, whether crops fail due to the poor quality of GM seeds or pesticides, fertilizers and other inputs. This compensation would, of course, require greater regulation of the market products, which are of spurious quality on the part of the government. The greater availability of institutional credit and elimination of the informal credit market from where part of the spurious and low quality inputs are being supplied will help the extension of this crop insurance scheme.

Build and Strengthen Local Cooperatives: Because the Maharashtra Cotton Monopoly Procurement scheme has been withdrawn and the private sector bodies and ginning associations do not serve the cause of indebted farmers, better marketing institutions that can ensure fair prices to cotton farmers need to be developed in Vidharbha. Local cooperatives that have been successful in Gujarat as well in the case of Western Maharashtra and which have received government assistance need to be facilitated in Vidharbha. Already there is a growing farmer movement in Vidharbha that has espoused the cause of economic distress for cotton farmers and has successfully lobbied the government towards getting loan waivers. This movement could be a starting point for creating these cooperatives. These bodies could also ensure greater accountability in implementing government rural employment programs.

Strategy 2: Introducing Integrated Pest Management for Controlling Pests: An alternative way of controlling pests, especially second generation pests, such as aphids and jassids which cannot be controlled by Bt cotton, is integrated pest management (IPM), a technique that relies on extensive information about the pest ecology to control pests in the field. IPM draws heavily on complementarities and interactions of different biological, chemical, cultural and mechanical methods (Birthal and Sharma 2004). IPM techniques consist of measures such as crop monitoring, crop rotation techniques, planting pest free rootstock, trapping and weeding (EPA 2006) along with bio-control agents and bio-pesticides. Methods like trapping and weeding are quite selective to the pests, and have proven their usefulness in large scale IPM programs. Pheromone traps have an advantage over other monitoring tools such as light and sticky traps. Methods such as the use of bio-pesticides are quite effective, for these are host specific and problems such as

resurgence of pests, secondary pest outbreaks, and insecticide resistance as in the case of popular insecticides are not reported in the case of bio-pesticides.

IPM modules have been developed for rainfed cotton as well, involving a number of practices such as:

- Crop Planting Practices: Any practice which delays fruiting will invite a greater attack by insects and diseases. High plant population, excessive nitrogen rates, late planting and excessive irrigation and moisture rates extend the fruiting period and need to be avoided. Early harvesting with no ratooning and stalk destruction restricts food availability to key pests, thus helping keep the pest population low.

- Predators and Parasites Related Practices: Natural predators such as coccilenids, spiders, pirate bugs, larvae of green lacewings and parasitic wasps, particularly in early and mid season are useful in controlling the insect population, and hence should be encouraged. Some insecticides are more toxic to parasites and predators and should be used sparingly. Growing of tobacco, amarigold, sorghum, maize and cowpea is also useful. Maize interlaced with cowpea on the borders has proved highly effective in managing the sucking pests (Sharma 2004).

While IPM has been tried in a number of cotton regions, including Vidharbha,[8] it has not become a mainstream approach, primarily due to problems such as requirement of labor and expenses incurred. IPM methods require very careful monitoring and inventorying fields for pests and are quite labor intensive.[9]

Supportive Policy Measures*:* More concerted effort made to popularize IPM might help its widespread adoption. Economic incentives such as provision of subsidies and linking agriculture and credit to IPM could encourage farmers in switching over to IPM. Individual practices such as the increased production of bio-pesticides could also be supported. For instance, measures such as creating an

[8] Interview, K.R. Kranthi, Entomologist, Central Institute of Cotton Research, Nagpur, Maharashtra, 2006

[9] Interview, C.D. Mayee, Previous Director, Central Cotton Research Institute, Nagpur, Maharashtra, April 25, 2006.

appropriate infrastructure for transportation and marketing, training potential entrepreneurs and exemptions against taxes could stimulate production of bio-pesticides. Finally, making the market of chemical pesticides unattractive through fiscal instruments of taxes and excise duties and sales taxes on intermediary inputs can be an effective way to promote IPM (Birthal and Sharma 2004).

Pricing IPM: One of the problems in implementing IPM is that it is a very expensive technique. Most of these costs result from high labor demands. Thus, if this technique has to be mainstreamed, its labor cost must be reduced. This solution could be practical if farmers form cooperatives that allow costs to be reduced by sharing labor and other farming techniques. The local government bodies can be used for coordinating and helping to build these cooperatives.

Other Measures: Even if IPM is used, there are other measures that have to be instituted in Vidharbha such as better minimum support prices for cotton, small scale irrigation development, access to credit institutions and the building of local marketing cooperativ.

Strategy 3: Farming Organic Cotton: Given that pesticides are creating havoc in terms of costs to farmers' health and soil pollution, organic farming could be another appropriate solution for Vidharbha's cotton farmers. Organic farming is a systems approach that utilizes the natural cycles and biological interactions for crop production consisting of a variety of techniques such as composting, vermicomposting, green manuring, mixed farming, crop rotations, low use of external agro-chemical inputs, use of bio-fertilizers, and weed and pest control. To elaborate, measures like composting include the use of bacteria and fungi occurring in soil to convert surface organic matter into a rich, nutrient medium. Farm yard manures and compost have been reported to suppress the population of many plant parasitic nematodes when used in large quantities. Biocomposting is a new concept and it can

be prepared using green (nitrogenous) leaves and dry leaves (carbon materials) and can be made faster over traditional cow dung (Trivedi 2004).

Vermicomposting uses earthworms in the production of organic matter from crop residues, vegetables and fruit wastes. Green manuring uses green leaves which are put in soil and allowed to decompose, resulting in an improvement in the ensuring crop. Waste green plants are also incorporated into the soil. Dried leaf powders may also act as sources of nitrogen, phosphorus and potassium, thus boosting root and shoot growth. The growth of leguminous green manure crops increases the nitrogenous availability in soil. Green manures can be cultivated before or along with main crops. Crop rotations consist of families of annual and biennial crops grown in a planned pattern or sequence to break weeds, pest and disease cycles, and to improve fertility and organic matter. Biofertilizers are live and latent cultures of micro-organisms that convert nutrients into a form that is easily taken up by plants. These consist of two types, nitrogen fixing biofertilizers (Rhizobium in legumes, Azospirrilum, Azolla) and Phosphate Solubelisers (pseudomonas, aspergillus, and baccilus) (Trivedi 2004).

Facilitating Supportive Policies for Organic Farming: Organic farming is an emerging concept in India, and a number of private firms and donor driven networks are already operating in this sector. For instance, in Madhya Pradesh, about 6,000 farmers are cultivating organic cotton in 10,000 hectares. The private textile mills in the state are also encouraging the cultivation of organic cotton and pay a premium of 10–15 %. A private certification agency is conducting tests and certifying the crop (Organic Reprints 2007).

A small organization of 100 farmers in Vidharbha known as the Vidharbha Organic Farmers Association (VOFA) practices organic farming over a land area of

3,500 acres.[10] Similarly, organic farming is being run on a smaller basis in Vidharbha through an NGO called Yuva-Rural with funding from Swiss Aid.[11] Organic farming, while a sustainable option, requires an extensive and long-term support network for farmers, especially because farmers have been exposed to the chemical based methods of farming, but support in terms of policy already exists for organic farming. The Indian government has recognized the importance of organic farming and created a Working Group in 2001 under the Planning Commission, including the establishment of a 920 million USD National Project on Organic Farming (Menon 2002). The government has also created a Working Group on Organic and Biodynamic Farming under the 10th Five Year Plan which recommends subsidizing the organic inputs or production promotion schemes (Menon 2002). None of these policies are yet in effect; thus, they need to be strengthened.

Building Market Linkages: One of the reasons that organic cotton production has not yet gained momentum is poor linkages between producers and buyers and the lack of an assured price for producers (Singh 2006). Several of the world's largest companies have now entered the market such as C&A, Walmart and H&M. Globally, around 30 brands and retailers and 1,200 small and medium sized companies are consumers of organic cotton. While organic cotton continues to be a niche market, there are examples within India where local cotton production has been linked to global markets, such as the Maikal BioRe project operating in Madhya Pradesh (Organic Reprints 2007). Such linkages could be facilitated by the state and national governments for further development of organic cotton in India.

[10] Interview, Ram Kalaspurkar, Vidharbha Cotton Farmers Association, Nagpur, Maharashtra, 2006.

[11] Interview, Palash, NGO worker, Yuva Rural, Nagpur, Maharashtra, July, 2006.

Other Measures: Even while IPM will be used, there are other measures that have to be instituted in Vidharbha such as better MSP for cotton, small scale irrigation development, access to credit institutions and building local cooperatives for marketing.

Strategy 4: Farming Food*:* If the cotton farmers of Vidharbha have to switch to food farming from the virtual monoculture of cotton farming, greater acreage will be provided to soya bean, a newer crop and jowar, grown historically in Vidharbha.

Government Pricing Policies*:* As Chapter 4 suggests, it was the government pricing policies that worked against traditional crops such as jowar and made cash crops such as cotton more lucrative in dryland, rainfed areas or wheat and rice in irrigated areas; addressing these policies is necessary so that jowar (coarse millet) becomes a profitable option for cultivation again. However, before this is done, it is important to see if there is a market for this product given that the market structure has changed in favor of cash crops like cotton, which might be a hard task because once government policies, related institutions and ideology are set it will be hard to change them. As far as soya beans, the problem reported in Chapter 4 is the fluctuating market price. Devising price stabilization policies is necessary for soya bean if its cultivation has to be promoted. Besides soya bean and jowar, in the event that other dryland crops are promoted, then careful studies need to be undertaken to find out what these might be. Insufficient data exist that show what kind of livestock might be promoted in this region. During my fieldwork in 2006, I observed goat farming by the Banjara community as a livelihood opportunity, which could be promoted after careful thought.

Alleviating Soil Conditions to Grow Food*:* Even though the data are thin, Chapter 4 provides evidence that indiscriminate pesticide use has led to soil

degradation in Vidharbha. For food crops to be successful, soil conditions need to be enhanced.

Farmers Commercial Mentality Attuned to Growing Cash Crop Cotton: Cotton has been farmed for commercial purposes over the years, and farmers have become attuned to growing it as a cash crop. The fact that they are committing suicide instead of thinking of new options to diversify shows how deeply seated this mindset is among farmers. In order to make them switch to new crops or even crops that an older generation might have grown such as jowar, the government authorities would have to address the mentality that a hybrid seed-fertilizer-pesticides model is not the only model available to farmers.

Strategy 5: Eliminating Cotton Farming and Introducing Non-Farm Opportunities: A last option for the farmers could be to get out of cotton farming entirely, but that would be an extremely hard task to achieve because farmers have historically practiced cotton farming and do not have any other skills. However, the younger, most distressed generation (TISS 2006), who are not as interested in farming as the previous generation, could benefit greatly if such alternative economic opportunities could be created to suit their educational qualifications.

Supportive Policy Measures: Both local and state governments could play a significant role in creating such non-farm opportunities to offset the growth that is occurring in small and medium towns in India. One such small to medium town, the city of Nagpur, is experiencing high growth due to the impending airline cargo hub, which can provide opportunities for those farmers who are no longer interested in farming. Having alternatives to Bt cotton does not preclude the need to develop better credit or insurance networks in the area or to strengthen and ensure greater accountability of rural employment programs through local cooperatives.

Problems and Opportunities

Table 7.2 presents an analysis of problems and opportunities presented by each strategy outlined above.

Table 7.2: Problems and Opportunities Presented by Strategies

Strategy	Problems	Opportunities
Strategy 1: Continuing to use Bt cotton	1)High costs if Bt cotton is not introduced in indigenous varieties or if the local seed companies do not get adequate support for the government 2) Government's inability to regulate illegal seeds 3) Inadequate development of extension infrastructure for precision pesticide application 4) High costs of irrigation infrastructure	1) Higher increase in farmers incomes if seed cost is low 2) Bt cotton is one of the prime solutions available for reducing pesticides and hence increasing incomes and other solutions such as IPM and organic agriculture have not been as successful 3) Bt cotton has been introduced in India in 2002 and even despite lack of government intervention
Strategy 2: Introducing IPM	1) High costs, primarily labor costs 2) Inadequate extension systems for Instituting IPM	1) Cleaner technology than use of pesticides in cotton
Strategy 3: Farming Organic Cotton	1) High costs of growing organic cotton 2) Inadequate information regarding markets for organic agriculture.	1) Environmentally friendly 2) Better health of farmers
Strategy 4: Farming Food	1) Switching over to another food crops can be financially difficult 2) It might be hard to train the farmers to switch over to food farming	1) Provision of food security
Strategy 5: Non Farm Opportunities	1) Difficult to start 2) Training problems	1) Additional employment

Source: Author

Finally, the impact of the Bt cotton on farming livelihoods is mediated by a number of complex local, national and international factors. The government needs to intervene in many areas if cotton farmers are to make gains from GM cotton.

APPENDICES

APPENDIX A

LIST OF INTERVIEWEES

AtmaRam, Peon, Young Women's Christian Association Hostel, Nagpur, Maharashtra

Atul Shiras, JK seeds (a major seed agency), Nagpur, Maharashtra

Ashwin Sawalakhe, Reporter, Agro-one (local newspaper), Nagpur, Maharashtra

Ashok, Syngenta Seeds (a major seed agency), Nagpur, Maharashtra

Bhalerao, Department of Agriculture (local government body), Nagpur, Maharashtra

Bhagirath Chaudhury, South Asia Coordinator, International Service for the Acquisition of Agricultural Biotechnology Acquisitions (ISAAA) (an international non-profit organization), Delhi

C. D. Mayee, former Director, Central Institute of Cotton Research (body of Indian Council of Agricultural Research), Nagpur, Maharashtra

Chandrima Chaterjee, Confederation of Indian Textile Industry (an industry body that represents the Indian textile industry), Delhi

Damodar Ugadhe, Farmer, Wardha, Maharashtra

Desh Deepak Verma, Joint Secretary, Ministry of Environment and Forest, Delhi

Dongre, Scientist, Central Institute of Cotton Research, Nagpur, Maharashtra

Devinder, Art of Living (spiritual program), Manglurpir

Employee, Agriculture Department, Nagpur, Maharashtra

G. Padmanabhan, Scientist, Central Institute of Cotton Research, Nagpur, Maharashtra

Hemchandra Gajbhiye, Scientist, Central Institute of Cotton Research, Nagpur, Maharashtra

Khawale, Professor, Punjab Rao Deshmukh University (a local university), Nagpur, Maharashtra

Kishore Tiwari, Activist, Vidharbha Jan Andolan Samiti (activist group focusing on farmer suicides), Nagpur, Maharashtra

K.R. Kranthi, Entomologist, Central Institute of Cotton Research, Nagpur, Maharashtra

Imbadwar, Vidharbha Development Board, Nagpur, Maharashtra

Jaideep Hardikar, Reporter, DNA (a Mumbai based newspaper), Nagpur, Maharashtra

Linu Mathew Phillips, Researcher, Center for Trade and Development (a major policy NGO which is part of Oxfam), Delhi

Mohota, Mohota Textile Mills (a major textile mill in Vidharbha), Hinganghat, Nagpur

Naveen, Editor, Navrashtra (local Marathi newspaper), Nagpur, Maharashtra

Shiv Vishwanathan, Scholar, Center for Study of Developing Societies (a research organization), Delhi

Terry Ranney, Food and Agricultural Organization (international organization), Rome

TV Ramanaih, Department of Biotechnology (a central government body), Delhi

Manoranjan Hota, Cartagena Cell, Ministry of Environment and Forests, Delhi

Palash, Worker, Yuva Rural (non-governmental organisation), Nagpur

Pankaj Shiras, JK Seeds (a major seed agency), Nagpur, Maharashtra

Pramod Mahajan, Organic Farmer, Wardha, Maharashtra

R.V. Sinha, All India Biotech Association (an industry body focusing on biotechnology), Delhi

Ram Kalaspurkar, Vidharbha Organic Farming Association, Nagpur, Maharashtra

Raj Gupta, Rice-Wheat Consortium, International Wheat and Maize Improvement Organization, Delhi

Rucha Ghate, Researcher, Shodh (local NGO), Nagpur, Maharashtra

R. B. Singh, Member, National Commission of Farmers (a commission established by the government to study the agrarian crisis), and former Additional Director General, Food and Agriculture Organization, Delhi

Sandeep, Reporter, Lokmat (local newspaper), Hinganghat, Maharashtra

Shyam Wagadhe, Farmer, Wardha, Maharashtra

Saurav Mishra, Researcher, Center for Science and Environment (a major research NGO), Delhi

Sampath Kale, Activist, Pune, Maharashtra

Sunil Talatule, President, Ginning Association, Nagpur, Maharashtra

Vasant Sabherwal, Program Officer, Ford Foundation, Maharashtra,

Vilas Doipude, Public Relations Officer, Nagpur Irrigation Department, Nagpur, Maharashtra

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APPENDIX B

LIST OF AGRICULTURAL INSTITUTIONS AND RULES GOVERNING THE AGRICULTURAL SECTOR

Institutions in Agricultural Development

India is a federal country. The Indian economy is governed by Five Year Plans made by a body called the Planning Commission.The national constitution defines the spheres of responsibilities in the making of laws and the exercise of executive power between the central government and the Parliament, on one hand, and the state governments and legislatures, on the other. In the field of agriculture and allied activities, predominant responsibility for legislation and the exercise of executive power lies with the state governments; the central government has exclusive responsibility only for inter-state rivers and for fisheries outside territorial waters (Fan, Hazell and Thorat 1999). Most expenditures on agriculture and rural areas are made by state governments. These include expenditures financed from the states' revenues. The central government's expenditure is also channeled through the state governments (Fan, Thorat and Hazell 1999).

The central government intervenes in the following activities relating to agricultural and rural development: agricultural research and extension, setting subsidies, creating rural infrastructure, fixing minimum support prices, provision of crop insurance, procurement of agricultural commodities, provision of rural credit, storing of food grains and poverty alleviation. This it does through institutions and schemes such as Indian Council of Agricultural Research, National Agricultural Research Systems, Food Corporation of India, Commission of Agricultural Costs and Prices, Cotton Corporation of India, National Bank for Agricultural and Rural Development, Reserve

Bank of India, Ministry of Agriculture, Ministry of Rural Development, Ministry of Chemicals and Fertilizers, Ministry of Water Resources, Ministry of Science and Technology Policy, Ministry of Trade and Commerce, Ministry of Customs and Excise, National Agricultural Insurance scheme, customs duties and excise policies, fertilizer pricing policies, export/import policy, assistance in natural calamities, employment guarantee schemes and poverty alleviation schemes. The state government intervenes in the following activities related to agriculture such as provision of electricity, irrigation and flood control, farmer training, cooperatives, rural development, forests, extension, animal husbandry and market yards (Fan, Hazell and Thorat 1999). The exact balance of power between the central and state governments varies, but it can be definitively said that the central government is more important than the state government.

Regulations Governing the Indian Agricultural Sector

Most aspects of the Indian agricultural sector, including marketing, processing, and trade have been heavily regulated (USDA 2007). These regulations include strict controls on foreign trade, domestic marketing and interstate movement of agricultural produce, land ownership, taxation, labor, and investment measures. The main regulations that govern the agricultural sector are: the Essential Commodities Act, small scale industry reservations, the state agricultural marketing producing legislation, land tenure policies, credit policies, tax policies, labor policies, food laws, tariff rules and Foreign Direct Investment (FDI) Rules. A brief description of each is given below:

Essential Commodities Act of 1955: The Essential Commodities Regulation and Enforcement Act of 1955 provides authority to the Central and State governments to intervene in markets of essential food products. The government, through this

regulation, ensures food availability to the poor and protects consumers from possible exploitation by commercial traders. Under this act, the central government issues rules for regulating production, distribution, quality standards, movement, and pricing of essential commodities such as cereals, pulses, edible oils and sugar.

Agricultural Marketing Acts: The primary act governing marketing is the Agricultural Produce Marketing Act (APMA). The Agricultural Produce (Grading and Marketing) Act of 1937 (and 1986) empowers the government to fix quality grades, authorize commodity grading, specify labeling and packaging requirements, and confiscate substandard produce. In practice, inspection services are lacking adherence to these standards and grades. For instance, most Indian grain is traded based on the broad standard of "fair-to-average quality" with no formal grading, although some private buyers and sellers trade grains at premiums based on their independent quality assessments (USDA 2007).

Besides the APMA of the central and state governments, agricultural marketing is regulated by several other legal instruments, at the center and the state level, such as prevention of Food Adulteration Act (1954, 1964, 1976); Solvent Extracted Oil Order, 1967; Meat Food Products Order, 1973; Standards of Weights and Measures, 1973; Prevention of Black Marketing and Maintenance of Supply Act; Cold Storage Order, 1964, 1980; Consumer Protection Act, 1986; Bureau of Indian Standard Act, 1986; Milk and Milk Products Order, 1992; and Fruits Product Order, 1955, 1977 (USDA 2007).

Tax and Regulatory Incentives to the Food Processing Industry: In order to increase growth in the food processing industry, the Indian government has extended direct tax incentives, especially so after the economic reforms process. In 2004–2005, the Indian government announced a set of incentives for new firms that process, preserve, and package fruits and vegetables, which included a 5–year waiver

of direct taxes, and a 25 % reduction in taxes for the next 5 years. In 2005, India also increased tax incentives for the development of Special Economic Zones (SEZs), providing special incentives for firms, especially agro-processing firms operating in SEZs (USDA 2007).

In 2006, the new Food Safety and Standards Bill was passed to iron out the contradictory and complex policy environment that exists, which was a deterrent to investment earlier in the food processing sector. The 2006 Food Safety Bill establishes a Food Safety and Standards Authority of India to create science-based food standards and regulate the manufacture, import, processing, distribution, and sale of food for formulating an effective and transparent regulatory framework for attracting investment.

Small Scale Industry Rules: The small scale industry sector is a critical component of the Indian economy and agricultural sector. Most of the food processing sector is reserved for the small scale firms. According to the 1951 Industries Development and Regulation Act, this policy was intended to promote the small-scale sector with two objectives: (1) ensuring increased production of consumer goods in the small-scale sector and (2) expanding employment opportunities through small-scale industries. In the earlier version of laws governing small scale industries, the limitation on capital assets holdings for small scale industries restricted the establishment of large scale or vertically integrated food processing firms. However, the limit for fixed capital assets for small-scale industries has been increased over time and is currently set at 247,000 USD. In addition to the above, the manufacture of most agricultural machinery and many types of food processing machinery which was reserved earlier was "de-reserved" during 1997–2007 (USDA 2007). After 1997, a number of small scale food processing industries were removed from the reserved list, apart from the following six food processing industries, namely: pickles, chutneys,

bread, pastry, hard-boiled sugar candy, rapeseed, mustard, sesame, and groundnut oil (except solvent extracted) and ground and processed spices (other than spice oil and oleoresin spices) (USDA 2007).

Credit Policies: India's agricultural credit system is comprised of cooperative, public sector and commercial banks. During the 1990s, the growth of credit was slow and institutional agricultural credit has expanded about 19 % annually, with private commercial banks accounting for most of the expansion. Credit availability has increased after the announcement of the "farm credit package" in 2004. Another new mechanism that has been in use has been the availability and use of credit cards called "Kisan Credit Cards."(USDA 2007).

External Trade Policy: In terms of external trade policy, all except a few agricultural exports are subject to non-tariff controls, including import and export licensing and canalization through select parastatals. Agriculture was not included in the trade liberalization measures taken during 1991 and 1992, except for the relaxation of some export controls. At the end of 1992, about 60 agricultural and livestock products as well as 46 manufactured products, most of which were processed as primary commodities were subject to some form of export control. Since 1991, trade policy has undergone several changes. Canalization has been abandoned. The imports of most agricultural commodities have been decanalized. Imports of edible oil, pulses and raw cotton have been placed under the OGL scheme. Furthermore, providing minimum export prices has been withdrawn (USDA 2007).

State Sales and Agricultural Marketing Taxes: State taxes on retail sales and transactions in regulated agricultural markets form a major source of state revenue. Tax rates vary by state as well by product. In 2005, prior to of the introduction of the value added system, sales tax rates for processed agricultural products ranged from 8–23 %, with the largest states imposing taxes of 12–16 %. With

the value added taxes (VAT), these rates are likely to decline and converge across states. However, a great variation exists among the agricultural marketing taxes imposed on all agricultural produce at the first point of sale. These taxes include marketing fees of 1–2 % besides mandatory commissions and fees for cleaning, weighing, bagging and other services which are paid to private agents in the market. The reform of the State Agricultural Produce Marketing Committee Laws is already underway and may create more competition within private markets and reduce these fees (USDA 2007).

Direct Taxes for Food Processing Industry: The Indian government has also taken steps to create direct tax incentives for the food processing industry. In 2004–2005, a package of incentives for new firms was announced that process, preserve and package fruits and vegetables, including a 5–year waiver of direct taxes plus a 25% reduction in taxes for the next 5 years. In 2005, India also increased tax incentives for the development of special economic zones (SEZs). The government provided incentives for firms, including agro-processing firms, operating in SEZs, such as duty-free import of goods for development, operation, and maintenance of SEZ units; a 100% income tax exemption on exports from SEZ units for the first 5 years; a 50% exemption for 6–10 years and a 50% exemption of reinvested export profits for 11–15 years; external commercial borrowing by SEZ units up to USD500 million/year without restriction through recognized banking channels; exemption from central government sales and service taxes and exemption from state sales taxes and other state levies (USDA 2007).

Tariff Policy: Import tariffs have been simplified and reduced since the early 1990s. Peak tariffs or the rates charged for highly protected products for non-agricultural goods have dropped from 300 % in 1991 to 12.5 % by 2006. Import access has been improved through the removal of quantitative restrictions in 2001.

There were some reductions in applied tariffs and some reductions in applied tariffs, but bound agricultural tariffs remain high relative to other sectors of the Indian economy, and relative to most other countries. The Indian government has been reluctant to reduce agricultural tariffs that protect India's many small farmers and small-scale agribusinesses. Many of these agricultural tariffs are now set well below the WTO rules. Tariffs were reduced when domestic shortages led to significantly higher consumer prices for essential food commodities. More recently, India has reduced its applied tariffs for wheat and corn to zero. It has sharply lowered its tariffs on palm oil products to help to augment domestic supplies and to stabilize prices (USDA 2007).

Rules Regarding Agricultural Research: In order to increase research in biotechnology, the Indian government has made changes to three laws to clarify intellectual property rights. These include the Plant Variety Protection and Farmers Act 2002 and the National Seed Act 2002 (USDA 2007).

FDI Investment Rules: The recent Indian investment regulations allow investment rules to permit FDI up to 100 % in most sectors with an automatic approval, which includes investment in India's Export Oriented Units and planned Special Economic Zones. While FDI is permitted in agriculture, there are several sectors where it is not, including retail trading, except for wholesale trading and single-brand retailing; agricultural production, except for floriculture, horticulture; seed development; development of animal husbandry, fisheries; cultivation of vegetables under controlled conditions, tea plantations, and services related to agriculture and allied sectors; and housing and real estate (USDA 2007). In the case of foreign firms, these companies can enter either as incorporated or unincorporated entities. Incorporated firms can be established through joint ventures with existing firms, or as wholly owned subsidiaries of foreign companies. Unincorporated entities

can take the form of liaison, project, or branch offices of foreign firms. All profits, dividends and foreign investments can be repatriated except when non resident Indians invest in specific schemes. Regulatory restrictions on multi-brand retailing deter both domestic and foreign firms from investing in Indian agribusiness (USDA 2007).

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