The Kernel of Doubt: Agricultural Biotechnology, Braided Temporalities, and Agrarian Environments in India

by

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ABSTRACT

Genetically modified (GM) cotton, *Bt* cotton was introduced in India in 2002 through a joint venture company, Mahyco-Monsanto Biotech (India) Private Limited (MMB). It is a collaboration between the Indian agricultural company, Maharashtra Hybrid Seed Company (Mahyco), and the U.S. based agrochemical company, Monsanto, which is now acquired by byer. The way it translated in practice was that, the Indian seed companies purchased seeds from MMB and through conventional breeding techniques, made crosses between plants containing the *Bt* gene with cotton plants that are owned by the companies. From the very beginning of legalization of genetically modified *Bt* cotton, it emerged as the seed of certitude and doubt, of truth and ruse, of promise and disbelief at the same time. Debates were already brewing about the advantages of using transgenic cotton seeds as early as 2003. From "remarkable success", because of higher yields making India the second largest producer of cotton in the world, to "continuous failure" due to the increased resistance of the pests developed against *Bt* cotton over the years, to relating the use of transgenic seeds with massive debt cycles and farmers' suicides and large scale protests, the debate over the advantages or disadvantages of using transgenic seeds have been fierce and muddled. As Glenn Stone points out in "Constructing Facts", these opposing camps have their own "authenticating systems" that constructed their own "rules for facticity", while nullifying all others (Stone 2012).

This dissertation explores these radically different entailments of the introduction of a GM crop. My work is shaped by my long-standing desire to understand how agrarian lives and experiences might inform narratives of science and the environment at national and global scales. Some of the questions that this dissertation explores are, how do different communities like farmers, scientists, regulators who are positioned on opposing ends of the agrarian political economy, understand and work with GM seeds? What are the modes of analysis, abstraction and writing about them emerge in these different sites as the materiality of the seeds get constantly entwined with the practices and experiences of the communities I study? What remains and what gets submerged when we understand biotechnology in terms of partnerships between corporate enterprises and academia, biocapital, risk studies, or cost-benefit analysis?

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To Sadhu Baba

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Finally, I dedicate my work to the lotus feet of Sadhu Baba. It is through His eyes that I see the world, and the real world and the dream world seem interweaved at every moment.

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Introduction

"This year Rasi 659 has completely taken over the market", exclaimed Ashish Ghive, the owner of a seed shop, Satguru Field Shop, as we sat in his shop on a languid June afternoon. I asked him why and how does one brand of genetically modified (GM) cotton seeds eclipse all others in the market during a specific season. With a contemplative expression on his face, he replied, "Well, these are good ones of the lot. They did well last year. They are "research seeds", which means, the *lao* (cuticles) or the thin film of white hair on the leaves are thicker than some other brands and that protect the plants form pests." I interrupted and pointed out that all the seeds in the market are "research seeds" because they are manufactured by seed companies. He thought for a few seconds and said, "yes, true. It is also about craze for a few brands each year. Some brands like Nuziveedu, Mahyco, Ajit have made a name for themselves by winning the trust of farmers, but beyond that, it is hard to explain why one kind is sought after in a season."

This conversation is a microcosm of the paradoxes that have plagued agricultural biotechnology in India for almost two decades. Genetically modified (GM) cotton, *Bt* cotton, is the only legal GM crop that is cultivated in the country. It is difficult to find cotton seeds that are not GM, but at the same time, the value of these seeds, especially for the farming communities, is constantly in flux. If high yielding hybrids (HYVs) and machineries like tractors were the signifiers of modernization during the Green Revolution in India since the 1960s, in the past two decades, the genetically modified seeds themselves have been at the fulcrum of both scholarly debates and public imagination around the future of agriculture. From the very beginning of legalization of genetically modified *Bt* cotton, it emerged as the seed of certitude and doubt, of truth and ruse, of promise and disbelief at the same time.

Bacillus thuringiensis (*Bt*) is a soil bacterium. *Bt* genes are inserted in cotton seeds because they produce proteins that are toxic to cotton pests like American and pink bollworm that have historically been the nemesis for cotton in India. *Bt* cotton was introduced in India in 2002 through a joint venture company, Mahyco-Monsanto Biotech (India) Private Limited (MMB), which is a collaboration between the Indian agricultural company, Maharashtra Hybrid Seed Company (Mahyco) and the U.S. based agrochemical company, Monsanto. The way it translated in practice was that, the Indian seed companies purchased seeds from MMB and through conventional breeding techniques, made crosses between seeds containing the *Bt* gene with cotton plants that are owned by the companies. In 2002, Bollgard I was introduced that contained Cry1Ac gene. After a few years, in 2006, Bollgard II entered the market that has Cry2Ab along with Cry1Ac.

Other than this joint venture between the two companies, several other Indian companies entered into agreements of sub-license with MMB, and purchased the *Bt* technology by paying a lump sum along with royalties on the sale of every packet of *Bt* seeds that was being sold in the market until Monsanto lost a case in 2018. The case was filed by the Indian seed company, Nuziveedu Seeds Limited (NSL) and the decision of the court ended the rule of Monsanto collecting royalties from the Indian companies on the purchase of every packet of *Bt* cotton seeds. In a prolonged legal battle that began in 2003, NSL questioned the validity of patents held by Monsanto. In a fascinating series of arguments that centered on the nucleic acid sequence of *Bt* seeds, the Delhi High Court pronounced its judgements in favor of NSL in April 2018. I discuss this in detail in chapter 3. However, in the meantime, the price of *Bt* seed packets have been high throughout the decade of 2000 because of the Indian companies having to pay royalties to Montsanto. The price of each packet 450 Grams of *Bt* seed, was exorbitant when it reached the market--- around INR 1500 (1USD is equal to around INR69-70). The prices are decided every year by the collaboration between the central and state governments and therefore, each state has a different price. After protests from several quarters about the high cost of seeds, the prices have been lowered in the last few years with Maharashtra, the state where I conducted most of my fieldwork, setting a price of INR 740 in 2018. Even then, the price is significantly higher than soybean, for instance, a crop which is widely cultivated in the region, that can range anywhere between INR 45-150.

The decade following the introduction of *Bt* cotton witnessed some of the most bitter crises and debates around the present and future of agriculture in the country. Vying claims about the causes and implications of consistently higher yields of *Bt* cotton mostly in irrigated regions, ever-changing research in agricultural biotechnology by companies and research institutes, foundering or inadequate regulatory policies, large scale farmers' suicides, and the mushrooming growth of grey market selling transgenic seeds all have combined to create a complex plant biotechnology landscape, populated by disparate interests. The main purpose behind the introduction of the crop that was described by the Department of Biotechnology, under auspices of the Ministry of Science and Technology was resistance to insects (Lepidoptera) and the promise of higher yields. The introduction of *Bt* cotton aligned with the developmental goals of the nation that envisioned biotechnology as the key to increase agricultural production as well as combat the diseases that ruin acres of crops in the country every year (Scoones 2002; Stone 2012; Herring 2010).

After the approval of *Bt* cotton by the Genetic Engineering Approval Committee, the committee under the Ministry of Environment that approves the commercial cultivation of transgenic crops, on 26th March 2002, these seeds spread extensively across the cotton producing states of Gujarat, Maharashtra, Andhra Pradesh (Herring 2012). Debates were already brewing about the advantages of using transgenic cotton seeds as early as 2003 (Stone 2012). From "remarkable success", mainly tested on the basis of higher yields and resistance to pests (Qaim and Zilberman 2003), to "continuous failure" due to the dependence of agriculture on the monsoons and the variation of environmental conditions in different regions of the country (Smale et al 2010; Zambrano and Tripp 2009; Cartell 2006; Quyum and Sakkhari 2003) to relating the use of transgenic seeds with massive debt cycles and farmers' suicides (Kuruganti 2012; Shiva 2011), the debate over the advantages or disadvantages of using transgenic seeds has been fierce and muddled. As Glenn Stone points out in "Constructing Facts", these opposing camps have their own "authenticating systems" that constructed their own "rules for facticity", while nullifying all others (Stone 2012).

On 9th October 2009, the GEAC approved the commercial cultivation of *Bt* eggplant based on a stating that it is "safe" to plant *Bt* eggplant based on scientific evidence, and that it will be "effective in controlling target pests, safe to the environment, nontoxic as determined by toxicity and animal feeding pests, non-allergenic, and has the potential to benefit the farmers" (Recommendation by the Expert Committee that was reserached by Mahyco). The then Minister of Environment and Forests, Jairam Ramesh, however prevented the commercial sale and urged for further research by independent agencies (Jayaraman 2010; Rao 2010; Herring 2014). Ramesh further imposed a moratorium on the commercial cultivation of *Bt* eggplant on February 2010, "for as long as it is needed to establish public trust and confidence…and all stakeholders are satisfied that they are heard to their satisfaction" (Decision on Commercialization of Bt-Brinjal by Jairam Ramesh, reproduced in MoEF 2010). The proponents have consistently highlighted the increase of yield in cotton after the introduction of GM seeds that has made India the second largest producer of cotton after China, whereas, the critics have raised concerns about the high costs of inputs (seeds, pesticides, fertilizers) leading to farmers' suicides and agrarian crises, control of agriculture by large corporations, and have repeatedly questioned the safety of GM seeds for the environment and human health. There have been debates and discussions around the issue of patent as well.

The Era of Commercialization of Agricultural Biotechnology: A Brief History

"rDNA research is more than a brilliant scientific achievement… It is the beginning of synthetic biology. As such it marks a major change in the history of life on this planet" Robert Sinsheimer, Biologist (Sinsheimer 1976:2541).

"The invention of DNA and rDNA are the two greatest deeds—and probably misdeeds—of science in my time" (Chargaff 1976:32).

Erwin Chargaff, Chemist

After the Department of Biochemistry at Stanford University Medical School applied for patents in 1974, listing Stanley N. Cohen and Herbert W. Boyer as successful inventors of rDNA, there were both concerns about biosafety around research on biotechnology within laboratories as well as, the commercial sale of biotechnological products. Throughout the 1970s, important conferences and heated debates took place around the possibility of unintended consequences and risks involved in bringing together two unrelated strands of DNA through recombination. How could one reach the conclusion that two harmless DNA, when brought together, would not result in pathogens harmful for the organism? How bounded could the intended consequences be in gene splicing? Moreover, could consequences—intended or unintended—necessarily be predicted in every case of gene splicing? In other words, some of the primary issues debated in the conferences were: the safety of the scientists practicing gene transfer; the ecological and environmental effects if rDNA organisms escaped from laboratories like toxicity, pathogenicity, weed formation; the effects of toxins that genetically engineered organisms could produce in human beings; and what would count as biohazard. After several conferences across the U.S. the overarching need for regulation was recognized that resulted in the formation of Recombinant DNA Advisory Committee (RAC) in 1974 and the NIH *Guidelines* on rDNA research, which came out in June 1976. The NIH

Guidelines was the fundamental document in drafting the safety guidelines of using biotechnological tools in several countries, including India.

Brewing behind the controversies around the *Guidelines* and the document's subsequent revisions were concerns about nascent biotech industries and the scope—and limits—of their production of genetically modified organisms. By the 1980s, the possibilities of large-scale commercial production of genetically engineered organism was a reality hard to defer. The paradigm had already started to shift from concern about risks, to the relative relaxation of regulation based on the presumed *safety* of engineered organism, to finally, the immense promise of biotechnological methods for the pharmaceutical and agricultural sectors.

The first NIH *Guidelines*, from 1976, included two provisions restricting large-scale commercial research and use of rDNA organisms: first, any rDNA culture which was above ten liters in volume was prohibited, and, second, the "intentional release of an rDNA organism into the environment" was explicitly forbidden (Krimsky 1991:101). As Sheldon Krimsky explains, "since absolute containment was nothing more than an idealization, unintentional releases were considered unavoidable" (Krimsky 1991:102). By the late 1970s, a growing number of commercial interests in biotechnology surfaced. Although the NIH did not have direct jurisdiction over private companies, most of the developing biotechnology firms preferred to abide by the NIH guidelines. A primary reason could be the research and academic affiliations of many of the owners of biotechnology firms (Krimsky: 1991). Geoffry Karney pointed out two possible reasons for the companies abiding by the rules: "First, the possibility of tort lawsuits provides monetary inducement to comply with the Guidelines, which would probably be accepted as the standard of care against which alleged negligence would be evaluated. Second, the threat of statutory regulations, which the companies have sought to avoid, always exists" (Karney 1981:869). In the absence of any legislation, the NIH remained the central authority on major aspects of genetic modification, commercial or otherwise.

Concerns in the media and the broader public came to the fore between 1976 and 1979. The city of Cambridge, Massachusetts imposed a moratorium on rDNA research and passed the country's first rDNA law in 1977 (Bareikis: 1978). Following this step and growing concerns among the public, fifteen bills were filed in United States Congress between 1977 and '78 around rDNA research. But not a single one reached the House or Senate for a vote (Tooze 1981:869). Faced with serious concerns that the NIH was ill-equipped to protect the public from the commercialization of GM products, the NIH came up with the Voluntary Compliance Program, which required that firms "wishing to participate in the program first submit the composition of its institutional biosafety committee (IBC) to the NIH's Office of Recombinant DNA Activities for approval. Once

IBC approval came, a firm could file requests with the RAC following procedures similar to those of university petitioners" (Krimsky 1991:103). However, an important caveat needs to be mentioned here. The NIH handled academic and industry proposals differently: the RAC conducted closed sessions in its review of industry proposals to protect the privacy of information considered property of a specific company, a move largely debated even among members of the RAC.

The Voluntary Compliance Program was followed by a series of deregulations in the subsequent *Guidelines* and by 1981, companies no longer had to submit information on sterilization of the fermentation system or disposal of rDNA cultures, procedures that had previously been considered risky and thus had attached reporting requirements. And by 1983, a multi-tiered review system was established in place of prohibition against intentional release (Krimsky 1991:105). Soon after, permission for a series of field trials was granted on the grounds that these trials posed no threat to the environment.

The legislation of engineered foods, like all other kinds of food products in the U.S, lies within the purview the FDA. However, unlike non-transgenic foods, the Environmental Protection Agency (EPA) also plays a role in inspecting field trials. A significant turn in the history of GM foods in America took place with concept of "substantial equivalence," introduced by the FDA in the *Statement on Policy on Biotech Foods* (FDA: 1992) and through the *Safety Evaluations for Foods Derived by Modern Biotechnology: Concepts and Principles* (OECD: 1993). The notion of substantial equivalence forms the guiding framework for the production and use of genetically modified foods across US to date. The OECD report states:

> 'For foods and food components from organisms developed by the application of modern biotechnology, the most practical approach to the determination of safety is to consider whether they are substantially equivalent to analogous conventional food product(s), if such exist…The concept of substantial equivalence embodies the idea that existing organisms used as food, or as a source of food, can be used as the basis for comparison when assessing the safety of human consumption of a food or food component that has been modified or is new…If the new or modified food or food component is determined to be substantially equivalent to an existing food, then further safety or nutritional concerns are expected to be insignificant; Such foods, once substantial equivalence has been established, are treated in the same manner as their analogous conventional counterparts…' (OECD 1993:10-11).

This policy of substantial equivalence marked a paradigm shift in the concept of risk as far as GM foods are concerned. From risky until proven otherwise, the focus was now that these foods were safe until proven risky. The shift elicited serious critique from several scientific quarters. For instance, Millstone *et al* (1999) considered the logic of substantial equivalence "pseudo-scientific." As they put it, "without agreed upon criteria, the reasoning given for substantial equivalence is circular" (Millstone 1999:525-6). Other critiques pointed to a concern that had surfaced in the earlier days of rDNA research: based on the positioning effect of transgenes, given that it is not possible to predict the position of the foreign gene within the genome of the plant, is it possible to determine what other expressions or suppressions will take place (Krimsky: 2000). The only possible way suggested was a case by case assessment of engineered crops, rather than a blanket policy of substantial equivalence. However, this would necessitate extensive research on the possibilities of the behavior of transgenes---- a field that was unexplored in research in America. Despite the critiques, the policy of substantial equivalence provided a strong framework, on the basis of which giant companies like Calgene and Monsanto undertook large-scale commercial production of GM seeds.

In 1994, the first commercial GM food, Flavr Savr tomatoes produced by the California-based company Calgene, hit the market with the FDA concluding that they were completely safe for consumption (Jasanoff: 2005). The variety of tomatoes was produced until 1997, when, due to heavy costs it was taken over by Monsanto. Soon after, Bt soybeans and maize followed. The subsequent years witnessed a heavy influx of GM foods in the US market. Currently, two thirds of all GM foods produced in the world is from the US. The normalization of the use of GM foods is visible in the absence of clear labeling for genetically engineered products on the market.

The Case of India

In India, the introduction of biotechnology took a different trajectory. The potential of biotechnology was recognized by the 1980s that led to the formation of the Department of Biotechnology as a separate department within the Ministry of Science and Technology. There were efforts throughout the decades of 1980s and 1990s to invest in research on biotechnology, especially on developing pest resistant and drought resistant GM hybrids. Along with research, there was a strong emphasis to collaborate with the private sector because that seemed like the only way to achieve the scale of the dissemination of biotechnological tools that was envisioned by the scientific community and the political leadership at the time. However, the final decision of forming the collaboration between Mahyco and Monsanto that was primarily made by a few members of the Department of Biotechnology, completely overshadowed the research initiatives and the plans of production and sale that were being discussed over the past decade. The collaboration was made in the early 1990s, and not only was there no public discussion around this major decision that would transform agriculture significantly in the country for the next decade, several members of the scientific community who were closely involved with the formation of the DBT were unaware of this decision.

This secrecy and exclusivity in making the decision, a collaboration that was formed with an agrochemical company that was already known for several malpractices in agriculture, and the lack of trust of the larger public on the government, set the tone for debates and discussions around biotechnology in the decade of 2000s.

This dissertation emerges out of these disparate positions and stakes in introducing and continuing to use a technological object in an area like agriculture that is directly linked to the lives and livelihoods of large sections of the population in the country. When a technology has led to such diverse and adverse outcomes, how do different communities who are placed on opposite ends of the agrarian political economy--- like farmers, scientists working with the seed companies, regulators—understand and work with the GM seeds or agricultural biotechnology? How do the knowledge claims and practices that support or oppose this technology transpire and get sustained over time? What are the modes of analysis, abstraction and writing about them emerge in these different sites as the materiality of the seeds get constantly entwined with the practices and experiences of the communities I study? What remains and what gets submerged when we understand biotechnology in terms of partnerships between corporate enterprises and academia, biocapital, risk studies, or cost-benefit analysis? But, most importantly, what do practices and understandings around a technology mean for agrarian lives? This project emerges out of a long-standing desire to understand how agrarian lives and experiences might inform narratives of science and the environment at national and global scales.

Fieldwork

The center of my fieldwork, and thinking, is the agrarian space. But, at the same time, this project reads "against the grain" in anthropological terms in that it does not posit the "village" to be either a privileged object of study because of its spatial and temporal "otherness" to the urban centers of seed production or the bureaucratic black boxes that built science policy in the country, nor does it see the village as a locus from which to interrogate relations of caste and kinship, the significance of which is already well established within anthropology. Instead, weaving together the multiple materialities of the seed with the lived experiences of those cultivating them upends the idea that rural India is an endangered, vulnerable space where restorative and enlivening technologies and policies can find a testing ground. Instead, the dissertation conceives of the rural as a space ripe for the production of both resistance and critical social theory. I became interested in the theme of agricultural biotechnology when I was doing fieldwork for UNICEF in 2009 in two villages—Latur and Nandurbar—in the cotton producing state of Maharashtra in central India. *Bt* cotton had just been adopted there. Even during the early years when arguably the yields were perhaps higher because the pests had not developed resistance, there were stories of both success and failure around *Bt* cotton. But beyond the question of yields, there were critical ways in which the rhythm of agriculture was shifting with the cultivation of *Bt* cotton. And, that was because of the complex and intimate relation between the "scale" of the production of *Bt* seeds (when I started doing fieldwork in 2015, there were more than 40 companies producing *Bt* seeds and more than 1000 kinds of *Bt* cotton in the market) and the need for specific care and labor that are required for their cultivation due to the physiological characteristics of the plants (for instance, the roots of the plants are shorter than the pre-*Bt* cotton hybrids that makes it necessary to cut grasses and weeds as soon as they grow around the plants leading to an increased demand for women's labor). Agricultural biotechnology almost introduced a new language of agriculture that is more contingent and that contains mightier promises as well as bigger risks.

During preliminary fieldwork that I conducted in the first few years of my PhD, I traveled to around a dozen villages in Maharashtra to understand the experiences of farmers with GM seeds and the ways in which the life cycle of *Bt* seeds crisscrossed with the lives of farming communities and cycles of agriculture. It is during these visits that I recognized the immense importance of seeds sellers and the seed producing companies. *Trust*--- whether the presence or the lack of it--- as I discuss at several points of the dissertation, emerged as an important concept during my fieldwork. The seed sellers must constantly build trust for the "promise" of higher yield and the golden life, both of which are increasingly becoming spurious, much like the counterfeit seeds that are spreading throughout the cotton market across the country. That led me to conduct part of my fieldwork at a seed company, Nuziveedu Seeds Limited. I conducted the last leg of my fieldwork with regulators working with various government branches to understand the ways in which decisions around science and technology are made and the ways in which that impacts different communities of people. The multi-sited fieldwork that I ultimately conducted, emerged out of the overarching presence (of the seed companies) in the cotton market or the gaps (of the link between science policies and the experiences of farmers) that I encountered within the communities that were cultivating cotton or using their labor around cotton cultivation.

I carried out the first part of my fieldwork in Durgadaitya village in the Vidarbha region of the state of Maharashtra. Although the state is the second largest producer of cotton in the country after Gujarat, the agricultural context is more complex than Gujarat. Unlike Gujarat, where there is prevalence of "technological culture" where agricultural practices and choices have been shaped by the Green revolution of the 1970s that has "privileged and consolidated the social power of resource-rich farmers" (Shah 2008: 432), the entire Vidarbha region has historically experienced severe droughts with poor irrigation facilities that are available to fewer farmers than Gujarat. More support from the state (for instance, the price of *Bt* cotton has been lower in Gujarat than Maharashtra) along with the presence of several textile mills in the state, have provided the farmers with a better support system. Unlike Gujarat, the trope of the "progressive farmer"--- the curious minded farmer who is open to adopting new technologies and techniques in agriculture--- that was created during the Green Revolution, rarely found its bearings in Maharashtra. The state has also witnessed the highest number of farmers' suicides in the country. With all these complex, contradictory realities emerging and evolving at the same time, I was drawn towards this region in the country.

I had approached the All India Kisan Sabha (AIKS), the agricultural wing of the All India Communist Party of India (Marxist) during the summer of 2013 to locate a few families in the region with whom I could stay during my fieldwork. In January 1936, during the national conference of the Congress Socialist Party at Meerut in the state of Uttar Pradesh, there was a discussion by the left leaning Congress members about the dire state of peasants in the country that had been hard hit by the economic depression of 1929. It was decided that an organizing committee would be formed with N.G. Ranga and Jaiprakash Narayan as joint conveners to begin the All India Kisan Congress. By 1942, the difference of opinions between the Congress and the more left oriented leaders were evident and The All India Kisan "Sabha" (AIKS) was completely under the wings of the communists. It soon came to be formally controlled by the Communist Party of India (Marxist). During the post-independence years after the British rule ended in the country, that is, after 1947, the AIKS, recognizing the capitalistic developmental goals of the ruling Congress party, circumscribed the demands for itself:

"The army of the landless swollen with the addition of a host of evicted and pauperized rural artisans, further increased the pressure on land. Seething discontent was the inevitable result all over the countryside in India. The Patna conference of the AIKS noticed this change and the prevailing mass discontent. It therefore decided to fight back the offensive government, the landlords and the divisive forces, which had appeared on the surface, on the basis of a fresh charter of demands. The demands included distribution of surplus land, recording of share croppers, no eviction, jobs and minimum wages for agricultural workers, remunerative prices for major crops, reduction of prices of essential commodities and agricultural inputs, cheap credit etc. Besides, there were the questions of restructuring of Centre-State relations, defeating the game of communalists and separatists, and promotion of national integration."

(M.A. Rasul, 1989: x).

Even today, the demands and priorities of the AIKS are on similar lines. AIKS has led some of the most significant movements against the agrarian crisis that has emerged due to debt cycles and farmers' suicides over the past decade. During several conversations in the nondescript CPIM office in Mumbai with Ashok Dhawale, the President of AIKS, he suggested that I stay with Anil Gaekwad, a longtime associate with the AIKS and recently appointed as the District Secretary of Buldhana district in the region, who lives in Durgadaitya. Durgadaitya is a medium sized village with approximately 1200 people, where there are farmers with very small landholding (around one or two acres of land) as well as, those with larger acreage of land. All things considered, I decided to live in Durgadaitya and that eventually became the fulcrum of my dissertation. Not only did I get a chance to follow the cultivation process of a few families closely, by the end of my stay, I had spoken with almost all the families in the village.

During my stay in Durgadaitya, I started spending around two days each week at the seed shops that sell seeds, pesticides, herbicides and other agricultural products. Most of these shops have opened in the past 5-6 years. The seed sellers are the conduit between the seed companies and the farmers and they hold a very important position in the decisions that are made by farmers about seeds and the time of application of pesticides. Like most commodities, the seed shops sell the brands that have a higher profit margin. After each cultivation period is over, representatives from various companies visit the villages and collaborate with the seed shops to advertise their brands. I spoke with several representatives from various companies, but these companies still seemed like a black box that practically controlled cotton cultivation but there was no scholarly work on the practices or research within these companies. After trying for several weeks, I got access and conducted the next leg of fieldwork at Nuziveedu Seeds Limited (NSL), acknowledged as the largest cotton seed producing company in India. I spent my time there with biotechnologists and breeders who make crosses between *Bt* seeds and other varieties of cotton that are owned by the company to produce the most desirable *Bt* cotton hybrids.

Finally, the last leg of research was with scientists and regulators who are working with Ministries of Science and Technology (S&T), and, Environment, Forest and Climate Change (MoEFCC). The story of agricultural biotechnology in the country begins from 2002 when *Bt* cotton was first available in the market for commercial cultivation. I wanted to know how did this entire collaboration between companies and the move towards agricultural biotechnology was initiated in the first place. What were the political, economic conditions at the time that made such a collaboration possible? What were the visions and revisions of science that catapulted a technology in agrarian lives only to invoke palimpsests of complexities that delinked agriculture from sustainability of human life? For several months, I tried to meet with people from the DBT and Genetic Engineering Appraisal Committee (GEAC) under the auspices of the MoEFCC which is the body responsible for granting permission to companies to conduct field trials. I met a few people but they did not lead me to any definitive place. It was towards the end of fieldwork that I wrote an email to Dr. Pushpa Bhargava, a biologist who exerted tremendous influence on policy making around biotechnology since the formative years of DBT until the recent past. He was the Supreme Court nominee to the Expert Committee that was set up to inquire about the safety of *Bt* eggplant. I was fortunate to not only receive a chance to speak with him but spend more than a month to sift through his archive to find answers to some of my questions. Chapter 4 draws mostly from this serendipitous meeting.

Scholarly Intervention and Outline of Chapters

There has been an emerging scholarship on the political economy of engineered crops, with special attention being paid to the role of the market in agro-biotechnology (Kloppenburg: 1988, 2002; Nelson: 2001; Lien et al: 2004; Stone: 2002, 2005, 2010; Sunder Rajan: 2012); partnerships between corporate enterprises and academia (Stein: 2004); the role of society, policies and politics in the propagation or obstruction of GM foods in specific countries (Jasanoff: 2005); the role of media and public opinion around GM foods (Brossard et al: 2007); and the place of hybridity in the nature-culture conception (Haraway: 1997; Rabinow: 2008). As Glenn Stone points out in "The Anthropology of Genetically Modified Crops," the trajectories that the study of GM crops have taken in the recent past are that of "progressive commodification of agriculture"; "enclosure of the genome" through Foucault's notion of biopower; "the march of neo liberal economies," and "academy's relation to both industry and the state" (Stone: 2010).

Describing agricultural biotechnology as a social process that has had deep influences on agriculture over the years instead of considering it as only a technological intervention in agriculture, Jack Kloppenberg's "First The Seed" is one of the earliest works that looks closely at the emerging link between agriculture as a capitalist mode of production and agriculture as a social context. Kloppenberg asks, "have plant breeding and seed production become means of capital accumulation? If so, how has this been accomplished, and what has been its effects?" (Kloppenberg 2002: 8). He investigates this from various aspects of agricultural biotechnology--- by tracking the asymmetry of the flow of germplasm from gene-poor to gene-rich nations, by looking at science as an "activity of scientists" and labor of the breeders rather than a pre-given idea, and looking at the connection between science, agriculture, and social change by revisiting the "agrarian question" that was posed by Kautsky over a century ago.

Several scholars have studied the ways in which "life" has been entangled in webs of capitalism through the recent developments in biotechnology. As Stefan Helmreich, in "Species of Biocapital" points out, that most of "definitions of biocapital center (with varying emphasis) on two transformation: in biotic substance and in economic speculation and sentiment" (Helmreich 2008: 463). A variety of concepts like bioeconomy, biovalue, biotechnological mode of production, and biocapital have been used to understand the relation between biotechnology and capital. Kaushik Sunder Rajan's *Biocapital: The Constitution of Postgenomic Life* , for instance, studies the processes of the use of labor and commoditization to make products like medicines from the biological materials, in a way, where its is not only the population that is controlled (following Michel Foucault's notion of *biopolitics*) but the cells, tissues, and genes. Speculative finance enables the life science firms to create promissory value that provides the biology firms with capital to develop new products, and as a result, "realize value" (Sunder Rajan 2006: 129). Nicholas Rose's *The Politics of Life Itself,* on the other hand, shifts the focus to the "molecular", where social and human relations, or life, are constantly being defined and described in terms of the fungible, miniscule, molecule.

Focusing specifically on the splicing of genes in genetically engineered foods, scholars have also written about the "unintended tones of fear of the alien and suspicion of the mixed" (Haraway 1997: 61). Explaining this very dilemma associated with the concept of risk embedded within the nature-culture binary is Paul Rabinow's notion of "biosociality" (Rabinow: 2008). Approaching the human genome project through three levels—the initiative itself; the institutions and enterprises, like the biotechnology industry, through which concepts of life and labor are articulated; and the framework of bioethics and environmental ethics—Rabinow articulates "biosociality" as "nature molded as culture understood as practice. Nature will be known and remade through technique and will finally become artificial, just as culture becomes natural. Were such a project to be brought to fruition, it would stand as the basis for overcoming the nature/culture split' (Rabinow 2008: 241).

Some other scholars like Kean Birch have shifted the focus of biotechnology from commodity based approach (production, labor) to an asset-based approach (property, rent). An "asset", in Marxist terms, "is a tangible or intangible resource that can be used to produce value, and at the same time, has value as property. In contrast, a commodity is an object produced for exchange" (Birch 2012: 302). He grounds his analysis through the works of Zeller (2008) and Aspers (2007, 2009) to show that the distinction between asset and commodity approach has implications for how the realization of value though capitalist market exchange is understood. He shows that, in the move from Fordism to biocapitalism, "the individual is a coproducer of what he (sic) consumes" (Marazzi 2011: 500). Writing about how the autonomist Marxists have written about it, he syggests, "he is no longer simply the production of commodities that creates value; the consumption of goods and services along with the social and intellectual relationships that entails, also becomes an asset for companies" (Birch 2012: 315).

There is another body of scholarship that has linked national policy with specific social and cultural notions about biotechnology in different countries. Sheila Jasanoff describes the dialectic between science, policy and society through the processes of "normalization" and "denormalization" (Jasanoff: 2005) while comparing the case of GM foods in US, Britain and Germany. She writes:

"Vague, unnamed, and unbounded fears were specified and made tractable, or so it seemed, through evolving systems of framing, classification, calculation, and control," yet, "it gradually became clear in each country that the political acceptability of agricultural biotechnology depends as much on the trustworthiness of the supporting social and institutional arrangements as on the abstractions of scientific risk assessment"

(Jasanoff 2005:96)

In the case of the U.S., she argues, the closure of controversy was achieved through ongoing processes of deregulation. The process of deregulation simultaneously normalized the fear of risk and eliminated the grounds for expressing dissent on the issue of risk. Under an overarching frame of deregulatory policies along with the large-scale commercialization of GM foods, it is easier to dismiss any research or finding which attempts to bring back risk into the framework. For instance, when in May 1999, entomologist John Losey and his team reported in *Nature* their experiments, which had shown adverse effects of *Bt* corn on monarch butterflies, Monsanto dismissed the claims, contending that "this experiment was conducted in a laboratory, not in the natural habitat of the monarch butterfly" (Jasanoff, 2005: 109). She shows how the different political culture in Britain, Germany, and the United States lead to different ideas of democracy, citizenship, accountability, that in turn, lead to different understandings and evaluations of scientific and technological knowledge and decisions.

My work, in engagement with these different bodies of scholarship around biotechnology, begins with the possibility of thinking about a "third space" that Michael Fischer mentions in "Emergent Forms of life and the Anthropological Voice". In the fast-changing worlds of technoscience, societies facing trauma after a disaster, telemedia saturation, every physical and analytical space is characterized by complexity and multiplicity where binaries like north/south, primitive/civilized do not hold true. In this dissertation, I attempt to open third spaces by either showing how two contradictory realities co-exist next to each other (in chapter 1, for instance, where the category of "labor" is both a site of claim making and freedom on the one hand, and means of subjugation on the other), how materialities of objects like *Bt* seeds and practices and experiences of farmers are entangled in ways where it becomes impossible to understand a situation without honoring that entwinement, or how individual actions of regulators and scientists destabilize the imagined relation between science and the nation. The third space is relevant especially in this context of agricultural biotechnology where the debates have often been polarized. One of the larger points that I have attempted to make in this dissertation is that, the experience of the farming communities with agricultural biotechnology is complex, multi layered, where contradictory realities are entwined in their everyday experiences. Therefore, arguments that either consider agricultural biotechnology as advantageous or disadvantageous--- as have been the bent of several writings on GM cotton in India (Shah 2011)--- is not adequate to understand the complex experiences around agricultural biotechnology.

<u>Chapter 1, Two Sides of Labor: A Question of Human Condition:</u> From the first week of my stay in Durgadaitya, one of the most palpable themes that I encountered almost

every day was the difficulty of finding labor to do fieldwork once the monsoons would arrive. I heard barbed comments and sharp judgements like "those people", "their habits", and how "they are becoming beyond control". The relation between land and labor as two main factors of production in agriculture is well known. But in the context of agricultural biotechnology, the arc of the debates and discussions in policy, scholarship, and public participation, has been around technological determinism in agriculture, corporate control over biological materials, environmental consequences, and the formation of "agrarian crisis" with unprecedented number of farmers committing suicides due to the increasing input costs of seeds, fertilizers, pesticides around the use of GM cotton.

This chapter brings back the question of human labor in the farm in the existing discussions around GM crops, but not only in Marx's terms of the mode of production debate, but labor as lived experiences that have emerged in the past decade of the cultivation of Bt cotton. The chapter narrates two contradictory yet simultaneous experiences of labor--- first, labor as an experience of subjugation, and second, labor relations as a site for protest and claim making, especially by women. I show this through the life of Ashish, a 22 year old laborer on the one hand, and women laborers on the other. For instance, every time I would strike a conversation with him, he would tell with a certain stubbornness characteristic of him, *"bolo na, pisa badhane ko. Kuch paisa* *hi nahi hai, kheti mein. Nahi karna mujhe kheti mein kaam*" (ask them to increase the money.. there is no money in agriculture.. I do not want to work in the field/ agriculture). He left Anil *bhaiya's* house a few times to work in shops , but ultimately came back. As Varsha *didi* would often pointed out, *"Ashish humare khatle ko chorke kabhi nahi jaega"* (Ashish will never be able to leave our home. No matter what he comes back here at the end of the day). If this sense of stagnation is one side of the experience of labor, the other side is the fact that the cultivation of bt cotton demands more labor, especially women's labor. For instance, the roots of these plants are not as deep as their predecessors, so the grasses and weeds need to be cut by hands at regular intervals so that they do not uproot the cotton plants. This work of cutting grass is solely done by women. Not only is it difficult to find labor to get these works done, the women would often enter into a fight amongst themselves during the hours of work as a way of creating breaks for themselves. The leader of these groups, usually called the *mukhiya*, can even refuse to work in a farmer's field if the women of her group are not paid in time or if they are not treated well.

I use the an iconic novelist, Premchand's classic novel *Godan* or "The Gift of a Cow" and Ranajit Guha's "Elementary Forms of Peasant Insurgency in Colonial India" as two texts that anchor these two contrasting experiences of labor. I then trace the place of labor within the history of peasant revolts in the colonial period and the new framers' movements in the past four decades. In the past decade, due to the unprecedented numbers of farmers' suicides and crop failure, the predominant themes of scholarship and farmers' movements have been to provide minimum support price for farmers, loan waivers in times of crop failure, and lower the input prices of agricultural products. I argue that using terms like "agrarian crisis" overshadows the long-standing problem of exploitation of labor in agriculture.

However, whether experiences of labor as subjugation in case of Ashish or labor as a site of claim making for women, I suggest, that ultimately, both are structures of indignity where the phenomenology of work is not valued or respected. A way of articulation and language needs to be created where the lives and work of agricultural laborers can be brought in not only as a question of wages but as a question of human value and who counts as human because that cannot necessarily be answered through either the category of class or caste. I try to bring these --- overarching yet invisible, like family but not completely--- people, the wage laborers, at the center of agrarian lives. I ultimately suggest that there is a need to move beyond the lens of labor to understand work in the field as a fundamental question of dignity of human condition.

<u>Chapter 2, The Good Seed: Braided temporalities and Agrarian Environments:</u> This chapter is a window into the circulation, movement, and meaning of *Bt* cotton among the framing communities. In 2015-16 when I was conducting fieldwork, there were

more than 40 seed companies producing around 1000 kinds of *Bt* cotton seeds in the market. This sheer scale and number of an agricultural commodity which is also the fundamental means of cultivation and livelihood for many, is unprecedented in India. During the entire period of my stay, an overarching inquiry among the farmers was, *"kaun si bijwai achi hai"*, or which seeds are good. Taking its lead from this question, the chapter asks, what is a "good seed" for the farming communities. Weaved into this broad question, it narrates stories of the role of unexpected communities like seed sellers in determining agrarian futures. The chapter argues that both agrarian experiences and valuation of the GM technology need to incorporate "contingency" or everyday unpredictable experiences at the center of its conceptualization.

I ethnographically show what I call "braided temporalities" or three entwined experiences of time among the farming communities--- the changing characteristics of *Bt* seeds themselves over time (pests developing resistance, infestation by new kinds of pests like white flies), the unexpected environmental contingencies each season (*Bt* cotton seeds are more delicate than their predecessors and the environmental conditions like monsoons affect them more adversely than others), and the edged fluctuation of the price of harvested cotton --- these three temporalities entwined in complex ways that challenge the notion of goodness of seeds that is based on production and yield.

The chapter further makes a connection between the seeds that are constantly changing and unstable, practices of farmers, and time. First, it brings forward competing conceptions of goodness of seeds, that does not allow for *Bt* cotton to be the ideal kinds of seeds. For instance, a farmer once explained to me, "a seed or a technology is good, when we are familiar with it, when we understand it". Chris Walley points out in "Rough Waters: Nature and development in an east African Marine Park", concepts of development are always contested and processual. Similarly, unlike the Green Revolution in India where science and technology were considered as the central way to modernize agriculture, in the case of agricultural biotechnology, the complex political economy of GM seeds, along with the temporalities that I write about, do not allow for biotechnology in agriculture to be a straight forward episode in the history of agriculture. By following the different phases of cultivation, the chapter unfolds the seed epistemologically as a *process*, that is discontinuous and staggered, rather than a bounded commodity. Second, It foregrounds agrarian experiences and connects them with the environment, a relation that has historically often been left separate in India. Agriculture and the environment began to be disjointed in South Asia during the colonial period when they were considered as either the source of land revenue or a resource for commodities like forest woods (Gadgil and Guha, 2013). My project takes its lead from what Arun Agarwal and K. Sivaramakrishnan write in *Agrarian*

Environments: "In the predominantly agrarian socio-economic context of India, studies that do not explore the connections of environmental changes with agrarian structures and processes, delink environmental politics from the agrarian worlds that is both the locus and the object of these politics" (Agarwal and Siva Ramakrishnan, 2000: 2). Using Pierre Bourdieu's notion of "practice", where he points out that the temporal structure and rhythm of practice are constitutive of its meaning, I show that the three temporalities shape both the practices of the farmers and unfolding of the seed, as well as, the specific points where they are deeply entwined. And, finally, I suggest that with the introduction of agricultural biotechnology, the experience of social time, to use Durkheim's notion, that is the time that is experienced together by the community, for instance, of sowing, harvesting crops, celebrating festivals together is changing because of the contingencies involved with the cultivation of Bt cotton. It is becoming more agile, adventitious, and haphazard. The rhythm, the ruse, and the rage of the *Bt* seed itself, the environment, and the market lead to checkered and inter-threaded experiences by framers and make GM seeds intrinsically *unfinished*, to use Heather Paxson's concept.

Chapter 3, Seed Matters: Continuing to read the seed as a *process*, in its amorphousness, distinctiveness, entirety, and unfinishedness--- this chapter looks at the production of GM seeds through the practices of the communities of breeders, biotechnologists, and lab assistants at NSL. The chapter asks the question, why and how did GM seeds come to acquire a myopic yet disproportionate focus in both scholarship and public discourse around agricultural biotechnology in the past decade? Reading beyond the "vibrant materiality" of the seeds to use Jane Bennett's concept, the chapter reflects on the process through which the seeds acquire their thing-ness, potency, and promise. By closely following the practices and the meanings that the breeding community and the biotechnologists and seed testers attach to the seeds, I suggest that it is within the space of the labs, through the practices of the scientists, and their experiences of time that the seeds become materially and epistemologically stable and bounded. As Harriet Ritvo, in "Race, Breed, and Myths of Origin: Chillingham Cattle as Ancient Britons" describes, notions of race and pedigree get reflected in the breeding processes, in the case of breeding different cotton varieties there are desirable traits that the breeders of *Bt* cotton want to incorporate within the plant that they produce. But instead of highlighting the work of the breeders who actually produce these seeds, I suggest that the granularity and objectivity of *method* that the biotechnologists, and seed testers follow within the laboratory to measure rates of germination, purity, or the presence of *Bt* genes, become the scaffold that constructs the seeds themselves as objects of certainty, objectivity, and calculated hope. It is here that the "good seed" is constructed. My work does not privilege the lab as the dominant site of knowledge production, but takes the 'field' and the practices of the breeders as generative. The second part of the chapter narrates a legal case between NSL and Monsanto that was going on while I was conducting fieldwork about the payment of royalties to Monsanto because they have patents over the bt technology and the specific nucleic acid sequence that they use. The court decided in favor of NSL because it considered the techniques of breeding as "essential biological processes" that are found in nature, and therefore they cannot be patented. The case brought about unique conceptions of what nature means.

Chapter 4, Biotechnology in History: *Techne*, Science, and the Nation: The chapter follows the history of agricultural biotechnology as it unfolded in the policy debates during the 1980s and 1990s. Science and technology in India have often been considered as the foundation of the developmental nation in the post-colonial period. This was envisioned and recurrently propagated by the first prime Minister of independent India, Jawaharlal Nehru. The other side of this narrative is the argument where scholars considered modernity, modernization, and science within it as "a continuation of state violence and stabilization of authority that had earlier characterized imperialism." Then, there is a middle ground, where science is understood as practice where networks are formed across lines of state, citizens, or colonized subjects. Following this third line of scholarship, the chapter circumscribes how individual decisions and efforts at certain historical moments destabilize both "nation" and "science" and the imagined relation between the two. Based on archival research conducted at the personal archives of Dr. Pushpa Bhargava, as well as oral history conducted with retired officials, the chapter reveals that the decision to bring Monsanto to India was made in a secretive and exclusive manner, mainly by the then Department of Biotechnology Secretary, CR Bhatia. This one decision set the wrong tone within the larger public about both the credibility of Indian scientists as well as the neoliberal policies of the government. In 2009, although the Ministry of Environment allowed for the commercial cultivation of *Bt* eggplant, the secretary of the Ministry, Jairam Ramesh, conducted public meetings in cities across the country and finally placed a moratorium on the commercial cultivation of *Bt* eggplant for a decade. The debates around agricultural biotechnology indeed unsettled this notion of supremacy of science and scientists, and connected the otherwise less-discussed field of agriculture with science policies at the national scale by bringing critique and dissent at the heart of both democracy and science.

Epilogue: Here, I write about the practice of doing fieldwork and the challenge of writing about the different kinds of "fields"--- literally, metaphorically, and anthropologically. To conduct fieldwork in a remote village and a cutting-edge seed company, and to write about them, not in a comparative way but in a way where there are overlapping, inter-connected themes, has been challenging. I have used this experience of contradictions as a method that has guided the writing of my dissertation. For one, the literal "field" of the farming communities and the "field" at NSL are embedded in very different histories, political economy, and practice. The field of a farmer is a means of livelihood and identity whereas the research field of the companies are more like experimental zones where contingencies play out very differently than in villages. Not only were the fields and the texture of fieldwork that I conducted were different, the knowledge, relations, and the analytic frameworks were often contrasting in these two sites. In the dissertation, I have juxtaposed some of these theoretical frameworks and genealogies of ideas, within the overarching association between materiality, practice, and time. For the book manuscript, I hope to create a *dialogue* between these contrasting fields of practice and ideas.

Chapter 1

Two Sides of Labor: A Question of Human Condition

I started for Durgadaitya village in the Vidarbha region of Maharashtra in April, 2016 from Kolkata, West Bengal. The Howrah Junction Railway Station in Kolkata was, as usual, busy with men carrying tin trunks on large wooden carts, passengers queued up for the daily mails, stalls with rows of weekly magazines, and sets of iron chains with lock and key that are used to secure one's luggage with the iron hooks under the berth of long distance trains in India. Covering a distance of around 1500 Kilometers from Kolkata towards the west, the Gitanjali Express was scheduled to pass through six states before reaching Shegaon, the closest town from Durgadaitya that has a railway station. Moving from one state to the next in India often gets revealed through changing landscapes, the way in which women drape their saris, or the language displayed on the yellow signposts mounted by the side of railway tracks. As the train creaked out of Bengal, one could see the change in landscape—acres of rice fields, ponds, and banana orchards were replaced by thick forests and rocky terrain of the Chotanagpur Plateau in Jharkhand (literally, the land of forests) state.

After journeying for a little more than 24 hours, I reached Maharashtra by late afternoon the next day. I got off the train at Shegaon by around 4PM. Part of the Buldhana District in Maharashtra, Shegaon has become prominent in the past decade largely due to the saint, Gajanan Maharaj, who is believed to have been an incarnation of Lord Shiva or Lord Dattatriya. Although details about his birth are not known, his appearance in Shegaon as a young man in 1878 has been documented. Sant Shri Ganjanan Maharaj Sansthan is the biggest temple trust in the Vidarbha region in the state and the temple attracts a steady stream of devotees throughout the year.

It was 46 degrees Celsius when I got off at the station. I had not experienced such blistering heat in the recent past. The air and the sun felt like a stacks of needles piercing ruthlessly though my skin despite my body being covered from head to toe in lose cotton garments. Anil Gaekwad's son, Nikhil, came to receive me at the station. I had learned about Anil *bhaiya* from Ashok and Mariam Dhawle. Ashok Dhawale is the President of the All India Kisan Sabha (Akhil Bharatoya Kisan Sabha or AIKS), the peasant's wing of the Communist Party of India (Marxist) and Mariam Dhawale is the General secretary of the All India Democratic Women's Association (AIDWA), the women's wing of the CPI(M).

AIKS traces its roots to the organization with the same name that was started in Swami Sahajanand Saraswati in 1936 to build a formal base for peasants that could protect them from the landowners or *zamindars*. This organization emerged out of several peasant movements throughout the 1920s in the northern state of Bihar to protect the occupancy rights of the peasants and reduce exploitation of their labor as well as advocate for waiver of loans (Rasul 1989). It is striking how all these issues have gained renewed importance in the past decade and most of them have emerged in the context of failure of *Bt* cotton throughout the cotton producing belt in the country. I had met Mr. Dhawle at the Maharashtra State Committee office of the CPI(M), Janashakti, near Globe Mill Passage in Worli, Mumbai, after my first year of PhD. In an archetypical communist office with old, wooden desks and chairs in run down room with portraits of Marx, Lenin, Mao Zedong and several other communist leaders adorning the wall, we spoke for hours about the agrarian crisis in the country brought about by economic policies and the GM seeds. With his decades of experience with farmers in several villages in the state, he would speak about the national problems in agriculture and the bus routes connecting different villages in the state with equal dexterity.

When I had narrated the plan of my fieldwork to him, he had suggested I stay with Wamanrao Raipure, Secretary of the AIKS who lives in a small town, Malkapur, and with Anil Gaekwad in Durgadaitya. Over the next few summers, I lived in both Malkapur and Durgadaitya. While I was living in Malkapur, I traveled to several villages with Raipure *Kaka* (uncle) to get a sense of the broad experiences with *Bt* cotton in the state. I discuss some of those experiences in details the next chapter. Unlike

Raipure *Kaka's* exuberant presence, Anil *bhaiya* is more reserved and quiet. He had a percipient way of talking about life in the village, his experiences with land over the years, how agriculture has been changing in the village, his family, the ways in which marriages are fixed in the village, and the importance of caste in making alliances of any kind. He has ten acres of land, which makes him a medium farmer.[1] He inherited this land from his father who had three brothers, each of whom had ten acres. His four uncles (father's brothers) and their families have lived in the same space in the past with the house being spread out with small patios, little cemented corners, and hibiscus plants separating the different units. Anil *bhaiya's* father passed away right before I started fieldwork and another uncle had passed away three years ago. So now, Anil *bhaiya* and his family (Varsha Gaekwad, his wife, and Nikhil Gaekwad, his son) live in one side of the plot, and on the other side, his third uncle lives with his wife, next to the widower of his uncle who passed away a few years ago. Their hearths are separate and that began a few years earlier following internal strife among the brothers in Anil *bhaiya's* father's generation. The members of the generation after Anil *bhaiya* are mostly settled in nearly towns and cities and they visit the household over weekends or during holidays.

[1] Below 1 ha is marginal; 1-2 ha is small; 2-4 ha is semi medium; 2-10ha is medium; 10 and above is large

The ride from the station to the village in an auto rickshaw was a microcosm of the Vidarbha region and a re-inscription of all the images that I had saved in my mind about the region from recnt news reports. Acres of naked, fissured, greyish-brown earth getting shriveled in the afternoon sun with men in white, soiled clothes and women in bright colored saris ending their work in the fields before walking back to their village in large, effusive groups. In some of the fields, people were still completing last season's harvest of onions and ginger. I saw heaps of onions in some fields that were just being unearthed. The exasperation brought about in me by the extreme heat got transposed onto my reading of the landscape, as the auto rickshaw moved through the rutted, potholed, unpaved road that led to the village. I was longing to reach home.

As I walked up the thin path that led to Anil *bhaiya's* house, I encountered curious gazes of older men, giggles of children, and welcoming smiles of women who were chatting in small groups at the porches. Since I was walking with Nikhil and since Anil *bhaiya* often hosts party workers in his house, those gazes were neither unwelcoming nor suspicious. It is almost impossible to walk into any village, especially the smaller ones, without having formed any association with a person living there. According to the village elders, the village has been cultivating cotton for at least three hundred years. Having an unusual name for a Maharashtrian village, I was inquisitive about its nomenclature as soon as I arrived there. Sudha Patil, one of the oldest people living in the village, narrated how more than ten generations ago, there used to live a monster, *daitya*, in a fort right behind where the village is currently located who used to torture the village folks regularly. The goddess, Durga, arrived in disguise one day and entered into a battle with the monster to finally destroy him. It was since then that the village came to be known as Durgadaitya and a temple commemorating the victorious battle was built in Wankhed, the village on the other side of the river that separates Durgadaitya from this village.

After speaking for a while about my travels, family, and the plan of study that I would conduct in the next few months, we all had dinner with handmade bread, cauliflower curry, and lentils followed by mango juice that was characteristic of the summer season. I soon learned about the acute water crisis in the village and the Vidarbha region in general. That morning, they tried to dig the well a few feet further to access the groundwater. The wells in all the houses had dried up because of delayed monsoons. Towards the beginning of my stay, I had to master the art of living with as little water as possible and the women of the house taught me about the techniques of doing that. We ended the first day early.

From the first week of my stay in Durgadaitya, the two most palpable themes that I encountered almost every day were the shortage of water and the anticipation of the rains, and the difficulty of finding labor to do fieldwork once the monsoons would arrive. The monsoons were unusually delayed the year before, and any further delay this year would make it impossible to start cultivating cotton. But the conversations around the difficulty of finding labor seemed like an issue that was deep rooted and complex to address. The simmering tension about the shortage of labor in the village that would reveal itself the moment the rains would arrive and it would be time to sow the cotton seeds, was usually coupled with barbed comments and sharp judgements about "those people", "their habits", and how "they are becoming beyond control". The relation between land and labor as two main factors of production in agriculture is well known. But in the context of agricultural biotechnology, the arc of the debates and discussions in policy, scholarship, and public participation, has been around technological determinism in agriculture, corporate control over agriculture in the past two decades, environmental consequences, and the formation of "agrarian crisis" with unprecedented number of farmers committing suicides due to the increasing input costs of seeds, fertilizers, pesticides around the use of GM cotton. This chapter brings back the question of human labor in the existing discussions around GM crops. The preponderance of concerns around labor led me to follow the issue throughout my stay in the field.

What is different about the situation of labor now that is invoking such discontent among farmers who hire labor every year? How is the cultivation of *Bt* cotton specifically contributing to build these narratives around labor? I begin to answer these questions by closely following the presence of Ashish, a young man of 22, who has been working for Anil *bhaiya's* family for the past ten years. Aspiring for higher wages and a better life, Ashsish would often enter into disagreements with Anil *bhaiya*. But ultimately, as Varsha didi would often mention, *"Ashish humare khatle ko chorke nahi jayega"* (Ashish will never leave our family/home). If this relation of dependence and being ensnared by the realities of labor relations exists on the one hand, on the other, the labor-intensive form of cultivation that is required to grow *Bt* cotton, has led to an increased demand for labor, especially women's labor in the field. There has been a shift in the past fifteen years where wages are determined based on the number of hours that the laborers work for instead of them working in the field for more than twelve hours every day. Labor has become a site to make claims and demands about higher wages or shorter time around the cultivation of *Bt* cotton.

I use two texts to anchor this chapter: first, a novel, "Godaan" or "The Gift of a Cow" that was written by an Indian novelist, Munshi Premchand, in 1936; and second, I draw upon "The Elementary Aspects of Peasant Insurgency" by Ranajit Guha. Considered as one of the greatest novels in modern Hindi literature, the novel is set in a village in northern India when it was still under the British rule. It is based on the belief that if any person can gift a cow to a Brahmin (the uppermost caste in the caste hierarchy), that person finds a place in heaven. The plot revolves around the central character, Hori Mahato and his wife, Dhania, daughters, Rupa and Sona, and son, Gobar. The central strand that weaves the story together is how Hori purchases a good looking, non Indian breed of cow from a herdsman, Bhola, which is eventually poisoned by his younger brother, Heera, because the latter grew envious of the attention and money that the cow was bringing to the family. In the meantime, Hori's son, Gobar, develops an affair with a lower caste woman, Jhuniya, and when she gets pregnant, Hori and his wife unwillingly accept her as their daughter-in –law. Hori, who was already indebted for buying the cow, is further immersed in debts because the village council levies taxes on him for allowing a lower caste woman to be part of the family. There are several sub themes, but ultimately, Hori dies because of being over-worked in order to pay back the debts and his long-term wish of buying a cow for milk as well as, to gift to a Brahmin while dying, remains unfulfilled.

Although weaved within the tapestry of the extreme destitution and poverty of the life of a peasant in rural India, the novel brilliantly holds complexities contradictions that village life entails. If, on the one hand, the character of Hori is that of an indebted, burdened, docile peasant who lives at the mercy of the landlord every minute of his life, Dhania, rebukes and challenges the authority of the landlord throughout the novel. Further, unlike some other women characters in the novel whose love and duty towards their husbands are unrequited but they still remain married and lead their live as powerless women, Dhania picks up a fight with several members of the family and the village, and expresses her grievances about the landlord or Hori's siblings openly. The peasant life depicted here is both dreary and helpless, but at the same time, the basis of caste and class hierarchies are constantly critiqued and challenged. The opening chapter in the novel makes this point clear when Hori is about to leave to meet the landlord and Dhania asks him to leave only after having a meal, a suggestion that agitates Hori because being late could have severe implications from the landlord's side. Hori exclaims to his wife, "You know how many people here in the village have been thrown off their land or had their property taken away. When someone's heel is on your neck, it's best to keep licking his feet" (Premchand 1968: 15). At this moment, the narrator's voice comes in:

"Dhaniya was less sophisticated in these matters. They ploughed the land of the *zamindar*, so all he should care about was the rent. True, these twenty years of married life had taught her that howevermuch she cut corners, skimped on food and clothes, and clung to every cowrie, it was still hard to pay the rent. But why should they have to flatter the landlord or lick his feet? She argued the question daily with her husband, refusing to admit defeat." (Premchand 1968: 15).

The similarities of peasant life in rural India in 1936 and now is dishearteningly several. Even with the introduction of several schemes for landless laborers and people of lower caste in the rural areas, the struggle for existence and the precariousness of everyday life are still overarching.

In the next chapter, where Premchand introduces the landlord, Rai Sahib, he writes: "Belari and Semari are two villages in the province of Oudh. The name of the district is of no importance. Hori lived in Belari, the Rai Sahib in Semari, just five miles away. In the last civil disobedience movement the Rai Sahib had become quite a hero by resigning from the Provincial Council and going to jail. Ever since he'd been held in great esteem by the tenants on his estate. Not that they had been shown any special concessions, or that the harsh fines and the forced labour had been reduced, but now all these evils were blamed on his agents. The Rai Sahib was considered beyond reproach. After all, the poor fellow was just another slave to the established system, which would continue in the future, as it had in the past, unaffected by any benevolence in his part" -

---- Premchand 1968: 23

Other than the complex and contradictory relations between landlord and peasants, and, men and women, the realities around caste depicted in the novel are also far from being straight forward. The entire plot is embedded in the consciousness and practices around the hierarchy between upper and lower castes, but simultaneously, there are aberrations that not only shake the foundation of the caste system but almost normalize anomalies. Hori's son, Gobar, for instance, falls in love with a girl who belongs to one of the lowest castes, Chamar, and ultimately marries her. There are other instances of upper caste men lusting over lower caste women with promises of marriage attached to them. There is an intertwined plot that depicts urban life with all its luxuries and individual independence. Further, there are constant references and associations to the nationalist struggle in the novel as well. But, both the depiction of urban life and the nationalist movement are presented with complexities where they cease to be the opposite of the drudgery of rural life. Ultimately, the novel shows that neither is urban life free, nor is the nationalist movement completely idealistic.

It is unfortunate and perhaps surprising how several themes and relations that are written about in a novel in 1936 are still relevant and present today. Whether it is the class oppression, struggles and contradictions among castes, or the prolonged indebtedness of peasants--- all these social and economic realities are still thriving. However, it is the many-sided, simultaneous depiction of rural life and its contradictions that is relevant for this chapter and that often slips out of debates around the mode of production, for instance. This chapter is primarily on agricultural labor as it has unfolded around the cultivation of *Bt* cotton in the past one and a half decades. But instead of considering labor as a stand-alone category that is a site of exploitation since the pre-colonial times, I show that labor relations are also emerging as sites of claim making and protest where laborers, especially women, are political subjects who are determining their rights and lives. Oppression and emancipation, familiarity and strangeness, continuity and change--- these binaries co-exist in ways where we need a third lens to hold their co-existence without losing site of the problems and limitations of each of these categories.

The second part of the chapter places the issue of labor in the larger historical context of peasant movements since the pre-colonial times. Although oppression by the landlords over the landless laborers and poor peasants has been a constant theme of peasant movements, since the 1970s, the focus has shifted to "remunerative prices" instead of class struggles. Since the introduction of the Green revolution in the 1970s and 1980s and biotechnology since 2002, there has been a move towards finding technocratic solutions to agricultural problems, where failures are addressed and compensated with solutions of money and further addition of technology. I suggest that there is a need to bring back the issue of labor not just as an economic category but as a question of practice and human condition. In this section of the chapter, I use "Elementary Aspects of Peasant Insurgency in Colonial India" as a part of the possibility of the way in which the issue of labor can be brought back to questions of "agrarian crisis". One of the foundational texts of subaltern studies, Ranajit Guha argues for the peasant as "a subject of history in his own right" (Guha 1999:3). The peasant movements where they are the makers of their own rebellions are often considered as part of the larger political and nationalistic struggles led by charismatic leaders. The British colonial administrators often attempted to use the directions and movements used in one rebellion to anticipate and suppress the ones in future. They were either considered "pre-political" (Hobsbawn 1969) or spontaneous. But ultimately, "the formative layers of the developing state were ruptured again and again by these seismic upheavals until it was to learn to adjust to its unfamiliar site by trial and error and consolidate itself by the increasing sophistication of legislative, administrative and cultural controls." (Guha 1999: 2).

Labor and Trust: The Figure of Ashish

"shram ka hisaab sirf paison se nahi gin sakte. Subah agar zaroorat hoti hai to hume majdoor mil jaenge lekin raat ko agar kisi cheez ki zaroorat pari to hum kahan dhoonde?"

(The calculation of labor cannot be done only through money. If we need laborers in the morning, we will find them but if we need help at night, where will we search?")

---- Anil Gaekwad.

"Money is not everything, brother. A man's sacred duty counts for something too".

--- Godaan.

The first few days passed by in learning about the ways of the household and the village. I learned from the women about the ways to live using as little water as possible because of water shortage until the monsoons arrived, got familiar with the roles of men and women in general, started to become familiar with families next to Anil *bhaiya's* house. Very early during field work, I noticed the ways in which class and caste are often expressed in the food that people eat and simultaneously, the transposition of these hierarchies in the ways in which consumption of food was talked about. The surname Gaekwad (or Gaekwad) in the Vidarbha region belongs to the category of "Other Backward Classes" (OBC), which is a classification made by the Government of India to provide concessions in educational institutions and government jobs to the educationally and socially backwards castes and classes. This administrative category is the third and most recently formed category to address social and economic backwardness outside of the other two categories--- "Scheduled Castes" (SC) and "Scheduled Tribes" (ST). The SC and ST are older categories that emerged during the colonial period to officially grant protective arrangements and affirmative action for people who have been historically disadvantaged. SCs usually belong to the lowest castes in the Hindu caste system. In Durgadaitya, the Gaekwads, although belonging to the OBC category, are of highest caste as the rest of the village mainly consists of castes lower than them and SCs. The Gaekwads consider themselves as "Patils", which means the chief of the village.

A daily meal at Anil *bhaiya's* place would include handmade bread made of wheat or rye, lentils, fritters made of gram flour, sometimes a vegetable, and mango juice after meals during the summer months. Next to their house, in a laborers' house of the same caste, the food would usually be handmade bread with pickles and green chili. Most people in Durgadaitya are vegetarians. The men of the families, especially the younger ones, sometimes consume chicken and goat meat but they are cooked outside the kitchen, in the courtyards, or slightly away from the village and is often a public secret. During my stay in the village, when I was invited by the Buddhist families (the lowest category in the caste system are the "Dalits" or "untouchables", a lot of whom converted to Buddhism because of social reforms initiated by BR Ambedkar in the 1950s), I was served fish curry cooked with a lot of oil and chili powder. Varsha *didi* and Manda aunty would often laugh at my indiscretion about eating food at anybody's place.

During the first few weeks, I was drawn towards the presence of Ashish in the household. 22-year old Ashish is a few years older than Anil *bhaiya's* son, Nikhil. Ashish started to accompany his mother, Ratna, when he was 12 years old. Ashish would be present in the house for long stretches of the day. He would watch television, talk to Anil *bhaiya*, run errands or just sit around. His mother and grandfather had been working for Anil *bhaiya's* family since the past four decades. I was drawn towards him because he would be present all the time in the house yet overlooked most of the times. He would slowly walk in and out of the house without anybody noticing him. Varsha *did*i would often treat him like a child but without the kind of love that she had for Nikhil. For instance, he would get to select which channel to watch on the television, but only when Nikhil would not be home. If both would be present, Nikhil would always have the final say about the channel. But when Nikhil would not be around, other than news times, Ashish would play whatever he wanted. I started living in the house almost two months before the cotton cultivation began, so the work in the fields was still a bit slow. He would spend several days in the house. He would come in the morning, go to his own home during lunch, and return in the evening.

Ashish cleaning and repacking lentils.

He works all year long but for cotton cultivation, his work usually begins by mid-April, when he starts preparing the field for the upcoming cultivation. In Marathi, they use the term *"mashagat karna"* which means to till or cultivate the land, to get it ready for sowing. Most of this pre-cultivation work is done by young men like Ashish. It begins with cleaning up the field by discarding branches and left over parts from the last harvest, followed by the tilling of the land by either tractors or with the country plough where bullocks are the main source of physical energy. The main work for Ashish before cultivation would be to fix the pipes for irrigation, which is time consuming. Like several farmers with medium landholding, Anil *bhaiya* uses drip irrigation, where water slowly moves from a tank across the field through pipes that have holes at regular intervals, form where water gets sprinkled in the fields. The seeds are sown next to each hole so that the water reaches directly to each seed. Ashish would connect the thinner pipes vertically across the field with the main horizontal thicker pipe that would carry water from the tank. Other than placing and fixing each pipe at regular intervals in the field, he would look for any major leak in the pipes and fix them. The entire process usually takes a few weeks. Along with fixing the irrigation pipes, Ashish would also sprinkle fertilizers throughout the field during this period. Once the monsoons would arrive and seeds would be sown, within a few weeks, Ashish, along with his friend, would do a few rounds of spraying pesticides in the field.

For the pre-cultivation work, Anil bhaiya pays around INR 700 (approximately $1= INR 70) per week to him, but for spraying pesticides, he receives the current rate of male labor in the village--- INR100-150 for four hours. For laborers like Ashish who receive money throughout the year, it is usually INR 100 during the peak cultivation season. For smaller fields, when people hire seasonally, the rate is higher to INR 150. Every time I would strike a conversation with him, he would talk with a certain stubbornness characteristic of him, *"bolo na, pisa badhane ko. Kuch paisa hi nahi hai, kheti mein. Nahi karna mujhe kheti mein kaam"* (ask them to increase the money.. there is no money in agriculture.. I do not want to work in the field/ agriculture). During my stay in the village, he reiterated this concern to me more than sixteen times. One afternoon, Ashish walked in, excited and speaking with a demanding voice. He was asking Anil *bhaiya* to raise his wages to INR 150. He excitedly pointed out that during the season of spraying different kinds of pesticides, everyone pays more than 100. He then asked Anil *bhiaya* if he could borrow INR 3000 because he wanted to buy the spraying machine instead of using a hired one so that he could rent it out and earn more . He was confused about whether to buy or not because it is an investment in an object which is only needed for certain phases during cultivation. He went home to ask his mother. He returned and said he would purchase the pump after all and return the money to Anil *bhaiya* by next season. In a few minutes, he said he would return the money through his labor. Anil *bhaiya*, in his usual calm and composed self, mentioned that lending money at that moment would be difficult because that was the peak of the cultivation season and he constantly needed money for various works related to the field.

Whereas Anil *bhaiya* was more reserved and kept to himself, Varsha *didi* often replied to his queries and questions in a joking way. Once Ashish left the house to run an errand, Varsha *didi* explained to me:

"During the peak cultivation period, their colors completely change. People who have an acre or two, they increase the wages during the spraying period. But we have a lot of land, how will it work if we increase wages? Also, we keep Ashish for the entire year. Whether there is work or not, we keep giving him money. If there is no work in the field, we ask him to run small errands and pay him for that. Around this time, people who do not have much land, do not own these spraying machines either. Ashish, therefore, wants to buy the machine and rent it to earn extra money. When *bhaiya* supervises, he works well. But when he is not around, he just works for an hour or two and comes back. *Bhaiya* knows that he does this sometimes but we do not say anything to him. He does not argue with Ashish. Last year, Ashish went away to work in a shop. *Bhaiya* never stopped him because he would get laborers anytime. At the shop, Ashish had to work from 8AM to 7PM and he would get INR 100. That also, he would often have to lift heavy things and work quite hard. He returned to our field within a month. His mother often says, he will never leave your family/ household. He keeps doing these things but he always returns here."

That night, while we all were having dinner, this issue came up again. With a slightly morose voice, Anil *bhaiya* told me that he keeps quiet because this is not Ashish's age to work in the field. It is his time to enjoy life--- eat well, spend time with friends, be taken care of. He lamented because Ashish had left his studies and started working in his field ten years ago. He also added that his mother, Ratna, has never taken care of him well. She returned to her natal village after her husband passed away. Sometimes Ratna finishes making lunch by late afternoon and Ashish returns from the field and stays hungry until 2-3 PM. Lamenting on the lives of laborers in rural India, he said:

"It is really not fair that they get such meagre amount after doing extreme hard work that is required in the field. Everything is more expensive these days. They just manage enough to get by somehow. But how can we pay? Agriculture has become so expensive with high prices of the seeds, pesticides, fertilizers, and all the different products that come to the market every year. And, if by any chance, the crops fail due to too much rains or pests, then there is nothing to fall back on for us. It is all very wrong."

Simultaneously, he would also talk about how money is not the only consideration when it comes to hiring labor. He reiterated what Varsha *didi* had said earlier about how they keep giving him money even when there is no work in the field. "Ashish evades work but overall you can trust him. His mother has been working in our fields for the past two decades. It is very difficult to trust laborers these days. You must constantly supervise them. It is not like even ten, twenty years ago when they would take care of everything. You could comfortably hand over the field to them. The money was really meagre--- they would get INR 10 and work from 5 AM to 6 PM. In turn, they were like family members. We would be there for them in times of need. After when they would retire from work, we would give them money, if they would have the habit of smoking *bidis* (indigenous cigarettes), we would buy them that. We would respect them as members of the family. You could leave the field to them and there was no need for tension. Now you just cannot do that. If you do not supervise, nobody will work. That is how things are these days. So even if you have to pay a bit extra, it is all right if you can trust."

"Bharosa" or trust is a word that emerged more than seventy times during my stay in Durgadaitya. The first few times I heard the word were in relation to the situation of finding labor in villages. During casual conversations at the seed shops, market place, or during more structured group discussions and interviews, I heard that trust is slipping out of the relation between the farmer and the laborers or *"mazdoor log"* (these laborer people), as they were often referred as. This difficulty of finding labor was expressed by farmers who had land that were more than an acre or two—farmers who needed to hire labor instead of working in their own fields. I discuss the changing labor conditions in the next section. Other than in the context of the existing labor situations, the lack of trust was used to express concerns about the environment, the seeds, pesticides and the various agricultural products that enter the market every year, the mushrooming growth of seed companies and the presence of their representatives in the villages every season, or sometimes the young people in the village who married without following the conventions of caste, class, or religion that guide most alliances. I

would hear, for instance, about this girl next door who ran away with a truck driver, married him, but later returned to the village because of abuse from him. Although this word was used in several conversations, the meanings, contexts, and implications were different each time. When it was used to speak about the current labor situation and the laborers, there was a clear sense of antagonism and abomination at the same time. Not only did the lack of labor in the village seem like an overarching problem, the lifestyles and attitudes of the laborers were the discussions where "trust", or its erosion, emerged as a central theme. Those who hired laborers expressed their active fear that work would not get done in the field because of the tendencies of the laborers to evade responsibility and only care about earning the daily wages.

As far as the environmental conditions are concerned, the word was used to express the unpredictability, especially the arrival of the monsoons that have been regularly delayed over the past few seasons, as well as the rise of temperature and its ill effects on the crops. The seeds, agricultural companies, and the presence of the representatives from the companies working as conduits of publicity for their brands, were considered untrustworthy because of the unfamiliarity and the lack of "guarantee" (another term that was used alongside trust), for either higher yields or the improvement of the soil, seeds, or the environment. Here, trust was invoked in the context of that which is not familiar or things that are not known, and therefore, one cannot gauge the outcome.

And, finally, about young couples breaking the boundaries of caste or even religion in finding their partners, trust was more like a language, a tool to make sense of the changing social, economic, and agricultural realities around people. It was not necessarily about nostalgia about the past where the conventions and rules around caste were stricter, although I did encounter some of that as well, but it was more about finding ways to understand and articulate this shift in the social norms where alliances like these are becoming more frequent.

I often worked in the inner room that was the oldest part in the house. *Dadaji*, Anil *bhaiya's* father, used to spend most of his time in that room. Unlike the rest of the house, that was built with bricks and cement, this room was built with mud and the walls were supported with wooden planks. It was comparatively cooler than the rest of the house, parts of which had tin roof that made the entire space quite hot during most of the summers. The room was mainly used to store grains and cotton in brown colored jute sacks until the price was high enough (which would usually be a few months after the harvest) to sell them. If not grains or cotton, the room would sometimes be used to store grains in tin containers for household use, a metal almirah, and a traditional bed that is made of wooden frames with a weave made of cotton. With the temperature, a few degrees below the scorching heat outside, that was my preferred room in the house where I spent my time writing notes, transcribing interviews, and taking occasional naps during languid afternoons. Anil *bhaiya* had fixed a low power bulb so that I could have some light while writing field notes every evening.

One evening, when I was writing down the events of the day, Varsha *didi* and Anil *bhaiya* walked in and placed a lock on one of the tins containing red lentils. I was surprised to see that because in the space of the village where people use very few locks (sometimes the houses would also be left unlocked even when everyone in the house would be away), it seemed odd that they were locking a tin of grain. Also, the way they both walked in to the room together added a certain seriousness to the action that I had only encountered during important decision making processes like deciding on which grain to cultivate in a season or how to conduct certain rituals. When I asked him the reason, he said, "Ashish stays at home all the time and although he is very trustworthy it is important to keep the money locked since he is aware of the nitty gritty of the house."

Although there is significant rise in out-migration of people in villages, especially men, to urban places, stories like that of Ashish are not uncommon at all. With the outmigration of laborers coupled with *Bt* cotton requiring more labor, finding labor whom one can trust has emerged as a critical issue in several cotton producing villages. And the figure of Ashish lies in the liminality of trust and mistrust, ambition and dependence, promissory possibilities (of working in cities and towns, for instance) that are unknown and the hardship of sedentary agricultural work that is familiar. It cannot be termed as the *jajmani* system or the traditional patron-client relationship because the rules are less rigid from both ends. Yet, like in Godaan, when the peasants are reeling under the extreme hardship of agricultural labor and indebtedness with few possibilities of emancipation and freedom, I encountered a similar hopelessness and stagnancy about life and work every time I spoke with Ashish or with men and women in the field, especially the younger ones. A young man, Shiv, told me while he was spraying pesticides in a field, "what kind of work is this? There is no money, nobody values us. I did not study enough to look for jobs in the city, so I am stuck here. We have hands instead of four legs so we do different kinds of work. Otherwise how are we different from the cattle that plough the field?"

Although agriculture has changed significantly since the introduction of the Green revolution and biotechnology, with commodities and products being an intrinsic part of everyday agricultural practices, both scarcity of labor and the increase of negotiation power by laborers (that I describe in the next section) as well as the feeling of stagnation and being tied down like Ashish and others from the younger generation feel, are simultaneous, co-existing realities in the village. Yet, unlike the peasant revolts during the pre-colonial and colonial periods, the farmers' movements over the past four decades have moved the discourse to remunerative prices by completely ignoring the need to address the question of labor.

Labor as a Site of Protest and Everyday Negotiation

"These days you really cannot trust the laborers. All they want is to make as much money as they can, and work as little as possible. They just want to eat, drink, and make merry all the time."

--- A farmer at Satguru Agricultural Center

"We get INR 100 for four hours now instead of working all day long and getting INR 10. Things are better than even ten years back. Whatever we have earned, it is because of our own hard work and because of Ambedkar."

Usha Raju Tayare, a small farmer belonging to the lower Dalit caste who converted to Buddhism under the leadership of BR Ambedkar.

It was one of the days of de-weeding and cutting grass in the field. The need to de-weed begins within 4-5 weeks of sowing the seeds. The frequency needed to cut grasses also depend significantly on the rains. Every time there is heavy rains, grasses grow and cover the entire cotton field in a matter of a few days. Herbicides cannot be used on cotton plants because they destroy the plants, so the grasses have to be manually cut and the work, like sowing seeds, is solely done by women across India. Usually, there is a woman leader, called *"mukhiya"* who has 10-15 women in her team. Whenever someone needs to hire women in their field, they call this leader. She sends the number of women that are required depending on the number of acres in the field. The wife or the mother of the farmer whose fields these women work in, usually supervises these women by standing in the area where work is being done and follows the women as they squat or bend over to perform their work. The male members of the family or the male workers usually do not set foot in these parts of the field where women work.

I was observing the way they were removing all the weeds and grasses from the field with their iron sickle, a tool with a wooden handle and a sharp, curved blade that is used to cut grass, forages, and used for harvesting of some crops as well. The women themselves were also talking amongst each other as they were cleaning the field. Suddenly, one woman said in a loud voice, "we started at 8 AM, not at 8.30", to which the *mukhiya* replied, "no, we were all here at 8 but we started soon after 8.30." In a few minutes, all the women (around 16 of them that day) came together and started a loud brawl. Some of them supported the woman who was claiming to have begun work earlier than what the *mukhiya* was stating. Some others agreed with the *mukhiya* and a select few chose to keep quiet and continued working. After around 6-7 minutes, Ratna, in an attempt to stop the fight, shrieked, "stop! Enough! Let us get back to work now!"

the altercation continued for another few minutes but along with doing their work. All this while, although Varsha *didi* was supervising the women, she could not intervene both because of her personality--- she is a soft-spoken person, and more importantly, because of her age. I heard from them that Anil *bhaiya's* mother would usually scream louder than the women and stop any fight that would brew during work. Although it is increasingly becoming common for women of households of medium or large farms or women of the upper castes to be present in the field, there are implicit codes of conduct especially for young women, where they do not speak too much or too loudly, maintain a certain distance from the women laborers, and often eat separately along with members of her own family rather than with the women laborers. The fight, ultimately, was not resolved but they got paid according to the rate--- INR 100 for four hours. Since they had decided to work until 2PM, each of the women earned INR 150 that day.

Later that evening, while visiting the house for tea, Ratna *didi* mentioned that it is becoming very difficult to stop these spontaneous disagreements and squabbles in the field. I had already heard about this several times since the beginning of my fieldwork in the village. The scarcity of labor was an issue that emerged during interviews with farmers who had land that were of sizes beyond 3-4 acres, and would be discussed with passion at the marketplace or in the shops selling seeds and other agricultural products, and within households. Statements like, "these people do not care about anything other than money", "they know we cannot do without them, so they behave as they please", "these days they have developed wings to fly. All they care about is money with no attention whatsoever to the work", or "laborers can really not be trusted these days. You have to constantly keep an eye on them" would come up every other day during my time there. The common contention was that when the laborers are paid by the hour, they often create a fracas in the field, but when, during the harvest season, they are paid by the number of sacks that they fill with cotton fiber, "they work as quietly as a mouse."

Bt cotton plants require more careful attention and *"mehanat"* or hard work as several people pointed out. They require more water than their non-GM hybrid predecessors. So, if the monsoons do not arrive by mid-late June, it becomes almost impossible to cultivate *Bt* cotton. Fertilizers need to be sprinkled around 2-3 times during on cultivation cycle. And, rounds of pesticide spray begin 3-4 weeks after sowing the seeds and continue at regular intervals throughout the cultivation period. The non *Bt* predecessors required one round of fertilizers and one or two rounds of pesticides spray. The input costs are also significantly higher with the total cost of seeds, pesticides, fertilizers and other agricultural products like growth hormones, labor prices for preparing and tilling the land, sowing seeds, cutting grass, and spraying rounds of pesticides anywhere between INR 15000-20000. *Bt* cotton also demands more water than most other crops and therefore, scanty or heavy rains impact the plants adversely. In drought prone areas like the Vidarbha region, the lack of availability of reliable, continuous sources of water has been the main reason behind several farmers moving away from cotton cultivation to soybean and lentils in the past five years.

The most significant change in the relations of labor has been in the need for women's labor in the fields that are growing cotton. The roots of the *Bt* cotton plants are not as deep as most of the earlier kinds of cotton. As a result, when grasses and weeds grow, they easily uproot the plant. They need to be removed frequently, especially after downpours when they grow quite fast and chaotically. During my conversations with people in the village who only have labor to offer and do not have any land of their own, they explained that the change in labor prices has taken place in the last decade. Based on my interviews with them, especially women laborers, I suggest that "labor"---as labor power in the Marxist sense, and as everyday lived experiences of the laborers---make it site of protest and negotiation, especially for women, over the past decade of the cultivation of *Bt* cotton. The desperation among farmers about the scarcity of labor and increasing labor prices and the disparaging remarks about them are the other side of the same coin where the laborers use "laboring" as a social relation where they exert themselves. Instead of the owners of higher landholding exploiting the laborers by making them work over and beyond the socially necessary labor time, in order to earn profit, the specific conditions that have emerged during the cultivation of Bt cotton have, in fact, led to a relation between time and money that works in favor of the laborers and not those who hire labor.

(Left) Women cutting grasses and weeds; (Right) A group of women returning home in an auto rickshaw after a day's work.

During most of my conversations with farmers who usually have more than 3 acres and cultivated cotton either when I was doing fieldwork or in the past, they repeatedly pointed out the difficulties of continuing with cotton because of higher prices of the inputs and the layers of uncertainty that I describe in the next chapter. But when I spoke with people who either had no land at all or who had 1-2 acres, they expressed a very different narrative around continuity and change in agrarian lives and about their work and labor. If not rethinking concepts like democracy and citizenship that Ajantha Subramanian writes in "Shorelines: Space and Rights in South India", where the struggle of Catholic fishermen to make claims on space and their livelihoods do not fit into either bounded cultural worlds or the logic of state power, the actions of the community of laborers are reconfiguring relations between land, labor, and technology.

There was a woman, Shobha Dadarao Wankhade, in the group of laborers that would usually work in Anil *bhaiya's* field, who grew fond of me towards the beginning of my fieldwork. She said she had a daughter my age and she would always invite me to her place. She was *"Baudhya"* (Buddhist) or from the lowest caste in the Hindu system, Dalits, who converted to Buddhism under the religious reforms initiated by Dr. BR Ambedkar. I went to her house for the first time on a day when the farm work had been halted because of the rains. Belonging to the lowest caste, most of the *Baudhyas* live at the outer edge of the village, right next to the road that connects the village with other nearby villages. The social distance from the rest of the castes for being the lowest caste would be transposed on to the geography and organization of space in the village---every time I would visit their place, I would be considered to have gone "outside" although it took me around five minutes to reach Anil *bhaiya's* house from the hers'. The walls of her house were adorned with framed posters of BR Ambedkar. As she fed me some delicious sweets and tea, we started talking about her life in the village. She narrated:

"Life is hard here. I wake up at 4AM, clean the entire house, make meals, and then leave to work in the field by 7.30AM. Working in the field is even harder. Now I am used to it, but it is very tiring to squat for so many hours in the sun. It is a lot of hard work. But things are still better than before. I was married when I was fourteen. During those days, we would work harder but get paid very little. We would get Rs. 2 or Rs. 3 after working for the entire day. It would be difficult to get even two meals those days. But now, the best thing is, we get paid by time. The concept of working in the field all day long does not exist. So, if I work for six hours in a day, I get INR 200. I have the rest of the time to do things for myself, my family. If I work for longer, there is a possibility of earning even more. My husband drives the auto rickshaw and works in the field. Together, we earn enough to get at least three meals a day and send our children to school that we never had the opportunity to do. We have made the house *"pukka"* in the past few years. Life is better now".[2]

When I asked her, what led to this change, she said, "it is our hard work and the fact that labor has become scarce". I asked, labor in the village has always involved strenuous, hard work, so how is it that, even ten-fifteen years back, they were paid around Rs. 10 after working the entire day? She said, "we have become wiser". And,

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[2] *Pukka,* in this case, implies a house made of cement as opposed to a mud house. Building a cement house is an aspiration that most rural people have. The word *pukka* also means "ripe", and is usually used as an antonym of *kuchha* or raw.

then, when I asked her, how did they become wiser, and is that why most farmers say that they cannot be trusted, she said that it is both changing times, increasing awareness among the laborers, and hard work. Her poignant description of changes in the agrarian life was echoed by several others who were in similar caste and class positions like her. As Bhagwan Samrak Ambore pointed out, "It was Ambedkar who changed things for us along with our own hard work. Earlier, the caste hierarchies were very strict. Poor people like us never had any chance of doing better, getting ahead in life. Now there is more work for us, our children can go to school, we have enough to eat. My son studies "technical" in school. Things are better now". Most people used words like *"parivartan"* (change), *"sudhaar"* (betterment), and *"pragati"* (progress) to explain how their lives have changed over the past ten-fifteen years. When I nudged them to explain why they feel that has been the case in the recent past, the most common replied I received were, their hard work, times are changing, and the production of *Bt* cotton. Some people highlighted the fact that the scale of cultivation has changed after the cultivation of *Bt* cotton. The money spent on inputs, time in the field tending to the crops, the need for labor--- all these have increased significantly in the past decade, creating more possibilities for work for laborers and those with small farms who also sell their labor in the fields of other farmers. As Christine Walley has pointed out in "Rough Waters: Nature and development in an east African Marine Park", concepts of development are always contested and processual. In this case, technology does not automatically lead to the construction and sustenance of the trope of the "progressive farmer"—a category that was often invoked during the Green Revolution years to signify a farmer who is open to adopting modern technologies and techniques in agriculture --- because of the complexities brought about by the community of laborers.

Most of the people I interviewed mentioned two more reasons for the reasons for a higher standard of living. First, taking ownership of the grazing land, what they call *"gairans"*, and second, the various housing schemes that have been initiated by the central government since the 1980s. *"Gairan"* means "cow land" (*gai*—cow, *ran*—land). During the colonial period, with the focus of agriculture being land revenue, the two main categories of land were cultivable or forest. The rest that did not fit into either of these categories were termed as "waste" (Singh 1986). Most of the villagers used this land to graze their cattle, sheep, and other animals. In the post-independence period, along with redistribution of land from the rich landlords called the *"zamindars"* to the landless, there was also an attempt by people inn villages as well as the state and central governments to make the grazing lands cultivable. The land reforms to redistribute land from rich landlords did not take off equally in all states, with Bihar and Uttar Pradesh being the pioneer, followed by West Bengal and some others. In Maharashtra, claiming grazing land, especially by the landless, poor, and Dalits became the predominant mode through which the resource poor section in villages gained both resources (in the form of land) and social status because owning land is always considered more respectable and valuable than being laborers without any land (Bokil 1996). During the Ambedkar movement, he encouraged Dalits and other depressed classes in villages to leave villages and migrate to urban spaces for work. Some scholars argue that this redistribution of small acres of land was a move from the richer farmers to retain the villagers who were initially bonded laborers. Whatever the history of acquisition may be, most of the members of the Buddha community mentioned this as a reason for the changes in their lives slowly over the past four decades.

Second, most of them have been beneficiaries of at least one housing schemes that have initiated by the government for the SC and ST communities in villages to convert houses from *kuchha* to *pukka*. There have been several schemes like Indira Awas Yojna, Shabari Adivasi Ghrkul Yojna, Pradhan Mantri Awas Yojna, Rajiv Gandhi Grameen Niwara Yojna, Ramai awas Yojna. Most members of the Buddhist communities availed of the Ramai scheme where they received a sum of INR 30,000 in three installments to construct their cement house. Although most people discussed the difficult bureaucratic processes, delays, and corruption around the implementation of these schemes, over time, they did receive some benefits of the scheme and managed to at least, convert part of their houses into *pukka*, cemented establishments. But both theses aspects of owning grazing lands and the housing schemes have been experienced by them over the past few decades. In the more recent past, of five to ten years, they explained that the increase in farm work due to the cultivation of *Bt* cotton transformed their lives. The shift from working all day long in the field to getting wages according to the hours of work, along with the increasing demand for labor in the fields, fundamentally changed what it means to live for these laborers.

Although most of the laborers, especially the women working in the field repeatedly mentioned how their everyday routines have improved in their favor over the past one and a half decade, they often mentioned how meagre the wages are despite the increase in the recent past. They would often jokingly tell me, "take us to America. There is no money here. Working in the field is a lot of hard work without much reward". Other than pointing out the problem of low wages, most of them who had little or no land mentioned that they are not valued or their work and lives are not respected. As Lata Nana Bhuzne pointed out, "if one of us dies, they will find another one. They will never mourn our death. They need us for their field but they do not care for our lives or value us as human beings". And, that is the reason every single person in the Buddhist community reveres Ambedkar because according to them, by freeing them of the caste system, he opened the possibility of people belonging to the lowest strata of the society to be human. The value of being human is certainly intrinsically tied to caste and class but not limited to it. When they spoke about their work in the field as "hard", they often compared themselves with cattle. It is not only difficult but it the conditions under which work is done in the field that, to them, often seems inhuman or sub-human. During my stay, two young boys died in the next village, Wankhed, because of snake bites while spraying pesticides. When this issue came up during some of our conversations, some people said, "yes, the life of a laborer is not worth much".

The experience of Ashish on the one hand, and the experiences of laborers negotiating their time and wages on the other, are indeed two sides of the condition of labor in agriculture--- unfree as well as free, stagnant as well as changing, dire as well as better. Yet, the missing link remains to be the fact that the work or their existence does not have value, respect, or dignity. The peasant movements during the pre-colonial and colonial period brought out the direness of the condition of peasants and landless laborers but in the past four decades, with the shift in orientation from "land to the tiller" to "remunerative prices" of the farmers' movements, the question of labor conditions has taken a back seat. A way of articulation and language needs to be created where the lives of agricultural laborers can be brought in not only as a question of wages or caste but as a question of human value and who counts as human because that cannot be answered through either the category of class or caste.

Peasants' Revolts and New Farmers' Movements: Locating Life in Labor

Peasant revolts in India have a history of over 200 years. During the seventeenth and eighteenth centuries, several peasant revolts broke out against the Mughals because of the extreme oppression by them in the form of high taxes and the local leaders slowly encroaching into tribal territories (Gough 1974). Some of the prominent ones were the Jats of the Ganges-Jamuna region from 1660s to 1690s and the Satnami religious sect that revolted against the Mughal ruler, Aurangzeb, for the revival of Jiziya (the annual tax levied on non-Muslims), and several Satnamis were slain in the process. During the latter half of the eighteenth century, there were even harsher and prolonged plunder extraction of resources as well as, imposition of taxes on the peasants by the British East India Company. The Permanent Settlement of 1793 in Bengal, Bihar, and Orissa, and even harsher settlements in some other parts of the subcontinent were mechanisms to regularize the heavy revenues that the British collected from land. The Permanent Settlement created the category of the *"zamindars"* as landowners, who were Indians and collected taxes on behalf of the British. These British land settlements, for the first time, introduced the capitalist structure where land became an object of private ownership rather than the certain individuals collecting revenue for the ruling power (Omvedt 1981, Thorner 1982, Gough 1974). During this period, there was a significant shift from food crops to cash crops like cotton, tobacco, tea, indigo, coffee because the landlords and the merchants benefited from the cultivation of these crops. This, along with the problem of absentee landlordism, transformed the more traditional paternalistic relations with the tenants, peasants, and the laborers that created renewed resentment among them. Simultaneously, there were recurrent famines across the subcontinent due to these changes in agriculture.

Based on the study of 77 peasant revolts in the country during the pre-independence period, Kathleen Gough, in "Indian Peasant Uprisings", distinguishes five types of actions based on the ideology, goals, and method of organization:
"1) Restorative rebellions to drive out the British and restore earlier rulers and social relations; 2) religious movements for the liberation of a region or an ethnic group under a new form of government; 3) social banditry (to use Hobsbawm's term); 4) terrorist vengeance with ideas of meting out collective justice; 5) mass insurrections for the redress of particular grievances." (Gough 1974: 1395).
Other than the ideology or goals, ultimately these revolts restructured the exiting relations between peasants and others in different ways. One of the most significant restorative revolts was the Sepoy Mutiny of 1857, that was started by both Hindu and Muslim soldiers but eventually, impoverished peasants, tribal chiefs, landlords, dispossessed nobles--- all these groups became involved with the revolt. From the 1930s, still under the British rule, the peasant revolts came to be organized by several socialist, social democratic, and communist groups. That continues even today although

the structure of the movements and their ultimate vision of change and restructure of the society has undergone significant changes. From the early part of the 20th century until the 1970s, these revolts that were organized by political parties, were either liked to the larger political movements of ending the British rule in the country, the need for political or territorial independence (like the Jharkhand movement for the autonomy of tribal communities like the Santhals), or were primarily class struggles.

The Tebhaga and the Naxalbari, both initiated in Bengal, are good examples of movements and uprisings led by the communist party. During the Tebhaga (which translates to "divided to three parts") movement in 1946-47, organized by the Kisan Sabha, the peasant front of the Communist Party of India, the sharecroppers (the tenants who were given a part of the land by the landlords to cultivate and share grains grown in that part of the land) demanded that they would pay one third, instead of half of the harvest to the landlords. The protests became violent and several landlords fled the villages, leaving the land in the hands of the party which eventually initiated significant measures to redistribute land from the landlords to the landless and poor peasants. Similarly, the Naxalbari movement began in Darjeeling in West Bengal in 1967, led jointly by the Communist Party of India (Leninist-Marxist) and tribal leaders where the peasants violently and forcefully grabbed land and food grains from landlords across the state.

The peasant movements, although spread across the country since the Mughal and the colonial periods, acquired specific characteristics in different regions of the country. Ending the colonial rule remained one of the central themes of several peasant movements but within that broad rubric, there were different demands and scales of agitation and rebellion in different parts of the country. In Maharashtra, for instance, the Deccan Riots of 1875, were primarily aimed to free the peasants of the debt peonage from the money lenders and the land lords in the region. The cycles of debt associated with the higher prices of inputs have been of the focal points of the farmers' movements around *Bt* cotton over the past decade. But Maharashtra has a long and specific relation to indebtedness that goes back to the pre-British period. In the 17th century, there were two categories of people as far as the relation between land and revenue was concerned—those who paid very little or no rent to the Mughal kings and those who paid high rent (Rao 2009). The former were mostly the Brahmans and Marathas who received large tracts of fertile lands as *"inam"* or land grants for services that they provided to the state. The other section, who had to pay high rent, were "tax paying peasants called *mirasdars* (holder of hereditary rights) and *uparis* (without hereditary rights)" (Rao 2009: 55). These two categories were mostly left with considerably infertile lands.

During the pre-colonial period, the *mamlatdars* were the people who collected taxes under the Maratha rule. Once the British took over in 1818, they retained the basic structure of tax collection but they placed the mamlatdars under the colonial collectors. The *ryotwari* system called the Bombay Survey system in the region was established in 1835 where a standard tax was levied irrespective of the quality of the soil or the scale of harvest. The increasing demand of land revenue from the colonial collectors led to the peasants using all the land for cultivation. Simultaneously, there was a boom in the cultivation of cash crops like cotton (Klein 1965). Both the need for the peasants to pay higher revenue, especially during the draught years, as well as the turn towards cultivating cash crops, were mainly financed by moneylenders who charged at the interest rate of up to 25% (Bhaduri 1977). The peasants would usually keep their cattle and land as mortgage and because of the inability to pay the high interests, the moneylenders would eventually usurp their land. The problem of indebtedness and the need to curb the power of moneylenders over the peasantry have been recurrent themes in the peasant movements in the region.

In the post-colonial period, an overarching theme in agrarian studies has been the mode of production debate. Most agrarian studies scholars at the time had some opinion about whether, during the colonial period and soon after that, Indian agriculture was moving from feudal to capitalist. Scholars like Utsa Patnaik, used Marx's *method* of analysis to comprehend the specific experience in India instead of applying the *model* of historical materialism. For Marx, capitalism emerges out of the internal contradictions of feudal or an earlier mode of production through a revolutionary process. She explained that during the Mughal period, there were no new production relations that emerged out of the peasant movements. During the colonial period, there was a "subjugation of a pre-capitalist mode of production by a capitalist power" (Patnaik 1972: 145). The land settlements during the British rule and the legal system was based on "bourgeoisie concepts of alienable private property and enforceable contracts" (Patnaik 1972: 145). She argues that agriculture cannot be termed as capitalist under the British rule because of this grafting of certain elements by a capitalist power. The *production* itself was not capitalist with no major effort to raise productivity of crops or improving techniques of cultivation. Further, one of the most important aspects of the capitalist mode of production is the creation of surplus value that is acquired by the extraction of labor beyond the socially necessary labor time. Capital, essentially produces more capital. Unlike the European case where there was an integrated movement form feudalism to capitalism, in India, there was no integrated movement form pre-capitalist to capitalist mode of production. The existence of wage labor is not enough to consider the relations of agriculture as capitalist because "wage labour in Indian agriculture went with the accumulation of colonial super profits by the bourgeoisie in Britain (as a result of complex exploitative relation of colony to metropolis)" (149). In fact, she further argues, that imperialism hindered any possibility of agriculture moving towards a capitalist mode of production.

Other scholars like Gail Omvedt argues that agriculture in India during the colonial period was primarily feudal, with strong elements of capitalism already arising at that time. She writes:

"Various types of zamindars, talukdars, khots, malguzars etc, controlled the lands in areas of zamindari settlements, even though tenancy acts under the British had already given substantial protection to the top section of the tenantry. Some of these tenants themselves… were essentially proto capitalist in character and needed the only final blow of Zamindari abolition to emerge as kulaks; others (such as Bengal Jotedars) were more feudal in nature in that they sublet the land to share-croppers rather than cultivating it themselves with hired labour." (Omvedt 1981: 141).

As far as the semi-feudal components of the mode of production was concerned, Omvedt writes, most of the "field labourers" during the colonial period were from the untouchable castes who performed several other labor services as caste duties. Although some of the legal definitions changed and contractual terms were introduced, servitude based on caste was still the norm in most villages. A lot of the labor in the field was also performed by artisans through this patron-client relation known as the Jajmani system where they were paid in the form of grains rather than money.

There is still a third theoretical position, where scholars like Hamza Alavi argue that what prevailed in agriculture during the colonial period, was neither feudal or capitalist but "colonial mode of production". There are some similarities between his and Patnaik's analyses, but Alavi attempts to build an analysis that is not only an Indian experience but can be considered a more generalized form of experience of imperialism around land and agriculture. Instead of restricting the analysis to 'relations of production' where forms of relationship between the worker and the exploiter are considered, he urges for a "totality of the "structure-superstructure" formation of a society that constitutes a dialectical unity" (Alavi 1975: 1251). Other than land becoming "property" rather than "possession" by the local lords, Alavi writes, there was a complete overhaul of the agrarian economy in the nineteenth century because with the development of infrastructures like railways, steamship, raw materials like cotton, indigo, jute were carried to England that was done through the destruction of industry and pauperization of the artisans. So, instead of exchange between local agriculturalists and local artisans, the "Indian economy was disarticulated and subordinated to colonialism. Its elements were no longer integrated internally and directly but only by virtue of the separate ties of its different segments with the metropolitan economy."

(Alavi 1975: 1257). Generalized commodity production did not have the same character in the colony because of this disarticulation. It was already a colonial mode of production. Alavi further explains:

"The destitution of the colonial economy and the relative lowering of the organic composition of capital (i.e. lower capital intensity of investment) in the colony was reflected in a lower wage level in the colony. That has provided an opportunity for profitable export of capital to the colonies in the case of those industries which are labour-intensive, so that a higher rate of profit could be realized thereby by metropolitan capital. It is in that context that we may consider the special role of the large number of destitute small holders—75 percent of all farms in modern India—in the colonial mode of production." (1257).

With the lack of possibilities of bare subsistence, members of these families were forced to find supplementary employment not only in villages but in urban places as well. They provided the largest base for cheap labor for the colonial economy. The small-holder class that was within the colonial mode of production, helped with the cheap reproduction of labor power for the British. But these conditions cannot be categorized as either feudal or capitalist but the only way to analyze this as whole, is to consider agriculture under the colonial rule as colonial mode of production.

Although these debates were taking place about agriculture in the colonial period, they were emerging at a time when "new farmers' movements" were springing up in several parts of the country. These farmers' movements started to carve out a significant identity and presence since the 1970s. Although there were discussions about what was "new" about these movements as far as the tactics used were concerned, there were some broad differences between the peasant revolts during the colonial period and these movements. The shift has been summarized by scholars from "land to the tillers" to "remunerative prices" (Lindberg 1994). Shetkari Sanghatana led by Sharad Joshi in Maharashtra and Bharatiya Kisan Union (BKU) led by Mahendra Singh Tikait in western Uttar Pradesh were more prominent ones but there were agitations in other states as well like Andhra Pradesh, Gujarat, Karnataka.

With the shift in methods of cultivation during the Green Revolution (the introduction of hybrid seeds in place of pure varieties, the use of machineries like tractors in several parts of the country, especially the northern states that have often been considered the poster child of Green Revolution, increased scale of the use of pesticides and fertilizers), the main demands of these movements have been to lower prices of inputs like seeds, fertilizers, lower tariff for water and electricity, loan waivers in the face of failure of harvests, and minimum support price for the crops. 'Farming is not remunerative after the coming of the Green Revolution' is their message and they claim that the calculations of the Agricultural Price Commission (APC) have not reflected the real costs involved. They also hold the view that terms of trade between industry and agriculture is increasingly developing in favor of industry and against agriculture" (Lindberg 1994: 95). As a result of this, although the prices of agricultural products increased, especially for the rich and middle farmers, it was difficult to keep pace with the increasing costs of nonagricultural products that they needed for their living.

Another characteristic feature of these movements has been the membership of these groups--- these movements were mainly led and participated by rich and middle farmers, instead of poor peasants and landless laborers who directed some of the peasant rebellions. These movements emerged in agriculturally more prosperous parts of the states where the farms were mostly irrigated that grew cash crop like cotton, sugarcane, and groundnut (EPW 1980). Their primary modes of public operation have been strikes and demonstrations (*dhrarnas, gheraos*), blocking roads and railways, or in some cases, withholding stocks of produce from reaching the market. These long marches and strikes have primarily been an appeal to the government to cater to their demands but within that framework, in most of these new farmers' movements, instead of a class struggle between the poor peasants and rich landlords, the "other" has been the industrial, urban India. This follows directly from the argument that developmental projects in post-independence India has been in favor of urban and not rural population. These are some of the ways in which the rural-urban inequalities were expressed through these movements:

"Bharat against India! Bharat is the indigenous name for India, with positive connotations, while India is the westernized name, symbolizing exploitation. They stand for the rural and the urban-industrial population respectively. The real contradiction is not in the village, not between big peasants and small, not between landowners and landless, but between the agrarian population as a whole and the rest of the society" (This was said by Sharad Joshi, quoted from Lindberg 1994: 96).

Gujarat's Bipin Desai expresses a similar point:

"The inner core is different. Our struggle is not for issues like electricity tariff or land legislation. We have a wider vision. The whole of the rural economy should be changed. It should not be a field for exploitation as it has been since British rule, a generating center for the national economy. The surplus should remain in the villages, and from this the appropriate growth of village based industries and development should be made rather than exploiting the villages to create a surplus for urban-based industries which only create unemployment and poverty" (Omvedt 1989: 9)

Some of the organizations were able to exert significant influence in the political configurations of the state where they functioned. For instance, in 1985, Shetkari Sanghatana supported the opposition candidates in the election that led to lower margin of votes received by which the member of parliament (MPs) representing the then ruling Congress party. That year, most of the opposition parties accepted the invitation of Joshi to attend the movement's Dhule convention, which affirmed the growing influence of the movement across the state (Lennerberg 1988: 446).

The movement for remunerative prices has been raised to a completely different scale in the recent past with the agrarian crisis brought about by *Bt* cotton. The scale of farmers' suicides across the cotton producing states in the country, has been unprecedented in the history of agriculture whether in the colonial or post-colonial times. More than 300,000 farmers have committed suicides in the past two decades and most of them are from the cotton producing belt in central India. Reminiscent of the marches in 1970s but with higher participation, the AIKS has organized long marches in the state of Maharashtra with two most significant ones--- on 12^{th} March 2018 and on 21^{st} February 2019. There were around 50,000 and 30,000 farmers participating in these marches respectively. They marched overnight from the city, Nashik, in Maharashtra to the state capital, Mumbai, covering around 180 kilometers'

A rally organized by the CPI(M) in Nagpur on 12th August, 2015

distance. Although these marches have been nonviolent means of protest, the participants were initially denied permission by the state government but they finally managed to overcome that obstacle. The demands of AIKS during these marches have been first and foremost, to pay minimum support prices to the peasants as recommended by the Swaminathan Commission that suggests the government pay one and a half times the cost of production to the peasants. Due to the consistent increase in cost of inputs, and the increased instances of pest attacks over the past five years where the *Bt* seeds are clearly being unable to live up to the promise of pest resistance, the cost of growing cotton has increased significantly over the past decade, especially the past 4-5 years. With the fluctuating prices of the fiber, sometimes they are spending more than what they gain by selling cotton. Therefore, providing the farmers with minimum support price and/or remunerative prices for the fiber have been considered as the main solution to the problem of agrarian crisis. Other than the immediate demand of loan waiver and remunerative prices, the important demand of the party has been to address the severe drought situation in the state with long and short term irrigation facilities by diverting the west flowing rivers that empty into the Arabian Sea into regions where water situation is in crisis (Dhawale 2019). Further, adequate food and drinking water, crop insurance, employment opportunities for the rural poor have also been demanded by the party.

While attending some of the shorter marches and speaking with party leaders like Ashok Dhawale, Mariam Dhawale, Biju Krishnan, and several participants, the template drawn by the party as a way forward, seems like the most comprehensive among the farmers' organizations that are active in the country in the present moment. Since AIKS is the peasants wing of the Communist Party of India (Marxist), most of the demands are nested within the overarching rubric of a critique of global capitalism and the neoliberal policies in India. Instead of the immediate need to address the agrarian crisis, there is a broader framework within which the agrarian situation is placed and some of the elements of that broader structure are the corporate forms of agriculture, continuous land grabs by multinational firms in the form of special economic zones (SEZs) along with the problem of few farmers holding disproportionate sizes of land, inadequate policies around the use of technology like GM seeds in the country that have led to the slow but steady pauperization of the poorer sections in the rural spaces.

The scale of farmers' suicide in the cotton producing belt that has led to the situation being termed as an "agrarian crisis" is ghastly. It is unprecedented in the history of agriculture in India. After the long march led by AIKS in February this year, both the central and the state governments conceded to several of their demands. The constant protests about the crisis also made it one of the central themes during the campaigns for parliamentary election this year. How much gets ultimately addressed, especially with the pro-industry Bharatiya Janata Party (BJP) being elected for the second term, remains to be seen. However, the fortification of this phrase and the subsequent demands by different parties to the state and central governments overshadow more prolonged experiences of indignity, drudgery, and the eroding notion of trust among agricultural laborers in the rural areas. If there is one issue that has remained constant throughout the pre-colonial, colonial, and post-colonial period, it is the deplorable human condition of the people who work in agricultural farms.

Hannah Arendt has critiqued Marx on the basis that he never made any distinction between work and labor. In *The Human Condition,* she has writes that it is unfortunate that in theory there is no distinction made between labor and work although in most European languages there is a clear distinction between the two. The book considers labor, work and action as the three fundamental human conditions or *Viva Activa*. The distinction that she makes between labor and work is the fact that the former sustains life whereas the latter creates the world of objects and in a way, transcends the impermanence of the life itself. And it is neither labor nor work but action (which she considers as the capacity of every human being to create a new beginning) that leads to the formation of the bios. Specifying the distinction between labor and work, she writes,

'The common characteristic of both the biological process in man and the process of growth and decay in the world, is that they are part of the cyclical movement of nature and therefore endlessly repetitive; all human activities arise out of the necessity; to cope with them are bound to the recurring cycles of nature and have in themselves no beginning and no end; ... unlike working, whose end has come when the object is finished, ready to be added to the common world of things, laboring always moves in the same circle, which is prescribed by the biological process of the living organism and the end of its toil and trouble only comes with the death of this organism'.

Arendt 1958: 98

It reminds one of the statement by Locke, 'the labour of the body, the work of our hands'. It is interesting to consider Arendt's work here because she is beginning her explanation of *Viva Activa* by taking two occurrences as her reference points: first, the advancement of nuclear technology which marks a transgression of the limits of nature by the humans and second, the advent of automation, an alternative to hard labor. The 'alienation from the earth' in the former case leads to human beings thinking that the natural limits can be challenged whereas 'alienation from the world' or the modern automated societies make human beings alienated from their own selves. One can notice an imminent crisis between science and spirituality in the works of Arendt.

Moving a step further, through the work of Simone Weil, one can proceed from the distinction clearly established between labor and work by Arendt to a sense of 'purpose' attached to the idea of work. After working in a factory for months and going through the tedious, monotonous process of drudgery and pain, Weil had expressed the urgent need of finding some meaning in one's work. Without some kind of finality, the process will lead to nowhere. And perhaps the only way out is to seek some kind of spirituality in work. "Work makes us experience, in the most exhausting manner, the phenomenon of finality rebounding like a ball; to work in order to eat, to eat in order to work. If we regard one of the two as an end, or the one and the other taken separately, we are lost. Only the cycle contains the truth" (Weil 1952).

The mode of production debate is still relevant in agriculture because despite the mushrooming growth of seed companies and the rampant use of various products like pesticides, growth hormones, fertilizers, especially in the cotton belt in the country, the basis of capitalism where capital begets more capital still depends on a complex set of issues. Especially for small and medium farmers, the cost price is often higher than the selling price of cotton, leading to net loss. There has been a consistent shift towards growing soybean by several small farmers in Maharashtra over the past five years. The movements organized by AIKS are extremely important in constantly building pressure on the ruling state and central governments to address the problem of higher input costs. But both the mode of production debate or these farmers' movements leave out the human and phenomenological conditions of being a laborer and doing labor in agriculture. There is a need for a language that is beyond the demand of "land to the tiller", which is increasingly becoming difficult with growing population and insufficient land for agriculture, or caste and class oppression. And, that language needs to emerge from the everyday experiences of doing work in the field and living life as a laborer where one does not feel valued or trusted. The answer does not lie in going back to a mode of production (like feudalism) or a way of living where the landless and the laboring groups of people are considered part of family only to be completely exploited, and therefore, be completely trusted, but in finding a space where the inevitability of their work is recognized and their experiences are at the fulcrum of understanding continuity and change in agriculture.

Chapter 2

The Good Seed: Braided Temporalities and Agrarian Environments

This chapter is a window into the circulation, movement, and meaning of *Bt* cotton among communities in the Vidarbha. In 2015-16 when I was conducting fieldwork, there were more than 40 seed companies producing around 1000 kinds of *Bt* cotton seeds in the market. This sheer scale and number of an agricultural commodity which is also the fundamental block and means of cultivation, is unprecedented in India. I conducted group discussions and interviews in around six villages in the region followed by extensive fieldwork in one village, Durgadaitya, where I lived with the family of a medium farmer and followed the cultivation process of his and another framer's farms closely. Simultaneously, I conducted interviews with around thirty families in the village. During the entire period of my stay, an overarching inquiry of the farmers was, *"kaun si bijwai achi hai"*, or which seeds are good. Taking its lead from this question, the chapter asks, what is a "good seed" for the farming communities to reflect on the complexity brought about by the *entanglement* of the materiality of a technological object with practices of the communities rather than considering either as separate entities. Weaved into this broad question, the chapter narrates stories of the role of unexpected communities like seed sellers in determining agrarian futures, emergent labor conditions, and unpredictable environmental threats. Tracing the value of the GM seed in its *use* by the farmers rather than its *making* by the seed companies, the chapter argues that both agrarian experiences and valuation of the GM technology need to incorporate "contingency" or everyday unpredictable experiences at the center of its conceptualization. I ethnographically show what I call "braided temporalities" or three entwined experiences of time among the farming communities--- the changing characteristics of *Bt* seeds themselves over the past decade, the unexpected environmental contingencies each season, and the edged fluctuation of the price of harvested cotton --- that are entwined in complex ways that challenge the notion of goodness of seeds that is based on yield. In this chapter, GM seeds are an intrinsically unfinished commodity and as a farmer once explained it to me: "a seed or a technology is good, when we are familiar with it, when we understand it". Recent scholarship in anthropology and history of science have used the concept of "braiding" to show the gradual incorporation of multiple threads of practices in reshaping an already existing body of knowledge, like the changing concept of the human body in Ayurveda, for instance (Mukharji, 2016). In my work, the conceptual category of "braided temporalities" helps me move beyond binaries like the cyclisity of agriculture and the linear movement of capitalism or the village as modernity's past and biotechnology as humanity's future. It foregrounds agrarian experiences in the anthropological scholarship on agricultural biotechnology.

Durgadaitya: Braided Temporalities

Temporality of the Seed

The Warwat market, that serves as the main market for several villages including Durgadaitya, would be alive in its everydayness when I started spending at least two days every week in two seed shops, encountering streams of farmers dropping by from nearby villages and inquiring about seeds asking many questions to the seed sellers. The heat was excruciating (it was 46 degrees Celsius the day I reached Durgadaitya) and every conversation among people would have an implicit, amorphous contemplation and anticipation for the rains so that the cultivation process could begin full-fledged. The specter of last year's unusually delayed and scanty rains was looming large across the entire Vidarbha region. As a customer at *Satguru Krishi Kendra* or Satguru Agricultural Center[3] pointed out during one of our candid conversations over a conical, striated glass cup of milk tea--- *"kapas ko to aasmani aur sultani dono maar pari hai"* (These days, cotton receives blows from both nature and administration).[4]

There are six seed shops in this market that have opened over the past seven years. They all carry brands like Mahyco, Ajit, Nuziveedu that sell the most in the area but

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[3] *Kendra* in Marathi and Hindi means center. It is worth mentioning here that most shops selling seeds, fertilizers, pesticides and other agricultural products add the term center along with their specific names, signifying their liminal position between being a shop selling commodities and a center disseminating practical agricultural knowledge.

[4] He was referring to the environmental conditions like the delayed monsoons that affected the cultivation process along with the ongoing discussions about loan waiver for cotton farmers that were going on at the national scale.

each shop has dealerships with different companies. When they are dealers of specific companies, especially the lesser known ones, they earn approximately 10-15% of the sale price of each packet of seeds as profit. Trying to lure the dealers, the newer companies provide them with a higher bonus than the older, more established companies in the market. Their advice to the farmers on seed choice is mostly guided by the logic of dealership. As Ashok *Kaka* of Bhagyoday Agricultural Center pointed out,

"Koi agar swadeshi cotton manga woh apne pas nahi hai. Humare pas Vibha, Bayer ki dealership hai. Hum use bechne ki koshish karte hai: kehete hai ki iska boll size acha hai, iski performance achi rahi hai pichle sal. Zyadatar log apne choice ka kuch lete hai aur humare bolne pe kuch packet lete hia. Abhi jaise ek jan aya aur JK8836 dena. Humne kaha bayer zyada acha acha hai. JK 750 ka hai, bayer 800 ka hai. who zyada acha hai. jhar ki quality achi hai, kam din lagte hai khate mein. Kashtakar kam din me utpadan hone wale varieties ko zyada pasand karte hai. Jo ghar se soch ke aye aur jise le gaye who hamesha alag hi hota hai"

(If someone asks for "swadeshi" cotton, and we don't have it, we try to sell Bayer's Vibha as we have the dealership for that. We try to sell that. We say, its boll size is good, its performance is good. Most people buy some of their own choice and some of what we recommend. For instance, just now, a farmer came and asked for JK8836. I said Bayer is better. JK is for Rs.750, this one is for Rs.800. The quality of the plant is good. It takes shorter time to grow. Farmers like seeds that yield faster. What they come in their mind with is usually different from what they go back with).

Although GM cotton seeds are arguably the most commodified seeds in the agricultural landscape in the country (Stone: 2007; Flachs and Stone: 2018), the process of acquiring them is more complex than most other commodities as the seeds often reside at the liminality of needs and desire (Baudrillard: 1968). With cotton as the primary crop of cultivation in several parts of central India, the *kind* of *Bt* seeds that the farmers buy become critical in determining their lives and livelihood during a season, and simultaneously, the billboards with advertisement of different kinds of seeds or the marketing kiosks that are set up to publicize the brands after every harvest, act as signs that conjure desire for the illusive perfect seeds. The seeds, and the process of buying them, are quotidian and extraordinary at the same time. I spent 2-3 days every week at *Bhagyoday Krishi Kendra* and *Satguru Krishi Kendra*. In late June, before the beginning of cotton cultivation, streams of farmers would visit the shops to inquire about seeds before buying them. I noticed several kinds of people with varying degrees of certainty about the brand and kind of cotton seeds that they wanted to buy. The journey and arrival to the seed shops were often an event for a significant number of farmers, marking a break from the prosaic everyday as well as from the last harvest. The older farmers, often with larger plots of land, arrived in their motorcycles, usually accompanied by a younger person like their son. Clad in crisp white cotton shirt called *pheta* in Maharashtra, *dhoti* or the traditional cotton garment worn by male Hindus to cover their legs, and the Gandhian cap, they sported a cloth towel, or *gamcha*, around their neck to wipe the sweat as well as complete the traditional look. The younger men wore cotton shirt with a pair of trousers. It is common among customers to walk in and ask for cold water, especially if they have been regular customers in these shops. They would sit for a while and ask which seeds were the most popular that season, when could one expect the rains, and discuss prices of onions, turmeric and other crops from the last season. Some others, usually with smaller landholdings, walked in in their soiled clothes, on their way back from the field, and stopped by briefly to buy a few packets of seeds. It was during one of those mellow afternoons of stray conversations with Ashish *bhaiya* (brother), Balu *bhaiya*, and Asok *kaka* in the shop, and encountering streams of farmers dropping by from nearby villages and inquiring about seeds, that the question, what *is* a good seed for the farmers, was conjured for me. Steeped in apprehensions about the weather, rising attacks by white flies over the last season, the price of seeds that year, I wondered what was the promise from the seeds that everyone hoped for? What did success or failure of seeds mean for them? What did it mean when farmers would ask about new seeds or good seeds?

Meanwhile, during the pre-cultivation months of March to June, the shops displayed shelves of multi colored promises, evoking desire for the perfect seeds. The seeds come in glossy plastic packets of bright orange, green, purple, usually weighing 450 Grams. Most of them carry magnified images of the cotton bolls in full bloom--- white and fluffy--- against the backdrop of a florescent color. The seed packets by popular brands like Nuziveedu Seeds Limited, Mahyco, and Ajit Seeds use the image of cotton bolls or an overtly content farmer holding a packet of their seeds with the brand printed in bold letters. A few others, like Jadoo (Magic) by Kaveri Seeds have a more creative imagery. A fluffy white chicken, resembling a cotton boll than an actual chicken, sits on a mound of golden eggs against a rainbow background covered with little stars, as a magician pops out of the brand name. The image of a super human muscular man emerging out of a cotton field in full bloom is another common image on these packets. Bhakti of Nuziveedu Seeds, a popular choice among farmers in villages that I traveled to, has been running an advertisement since the past three years. The introductory frame in the advertisement is a wedding scene of a Hindu family: The generous use of real marigold flowers to set the stage for the wedding and the attire and jewelry worn by the bride and the groom, clearly situates the event in a wealthy, land-owning family. As the camera focusses on the bride and the groom, they welcome someone with folded hands. The rest of the attendees follow suit. The guest is Prakash Raj, a famous south Indian actor, clad in crisp white *kurta* and *dhoti* and multiple gold chains dressed as a rich landowner, who presents a tray full of packets of Bhakti seeds to the couple and blesses them saying, *"aapka Jeevan khushion se bhara rahein"* (May your lives be filled with happiness). The second frame is the scene in a cotton field where he is inaugurating a water pump by pressing its switch and water gushing out of the pipe. He then presents a tray of the seeds to the family saying, *"aapka bhavishya ujval rahe"* (May your future be bright). The last frame is a close-up of Raj alone with the backdrop of a cotton field. He proclaims: *"Khushi ke mouke par aashirwaad sabke liye. Par who shabdo tak simit hai. Mera Bhakti unhe sakaar karega. Kapaas ki kheti ke baadshah Bhakti beej se khushhali aur aamdani dono badhegi. Sone jaise phasal ke liye Nuziveedu Seeds ke Bhakti beej chune. Bhakti mein hi hai asli Shakti"* (On happy occasions, blessings are for everyone. But they are often limited to words. My Bhakti will help realize those blessings. These seeds will bring in both happiness and yield. For a harvest of gold, choose Bhakti by Nuziveedu Seeds. Real power lies in Bhakti Seeds). As he utters the last few words, *"Bhakti mein hi hai asli Shakti"*, a gold trident magically emerges, signifying the ultimate blessing from none other than Lord Shiva, and he clasps it with a smile of pride and reassurance on his face. The frontiers of this advertisement are clearly beyond the first and the last frames. It draws from sedimented codes and associations in religion, myth, and technology as aspirational. The gift of seed packets at the wedding and at the inauguration of the water pump are never limited to being denoted messages. Plentitude is condensed in the seed packets and further through the cypher of big cotton bolls on the packets. The seed metonymically connects fertility and abundance in the two scenes of the advertisement. If marriage and agriculture are the two denoted themes, religion cuts across both as one of the connoted messages. Despite the transformation of the seeds from fundamental means of production to commodities (Marx 1939; Kloppenberg 2004), one can notice a recurrent need to build "trust" by the seed companies as well as the seed shops and it is often done by evoking both the familiar social and cultural contexts of religion or kinship as well as, the aspirational and futuristic promise of modernization and technology.

"Choice" has its own history and culture. It can be a double-edged sword, especially if it's swift and disjointed from other parts of a process. For the farmers, the presence of many brands is not the translation of the market principle of competition solving the problem of monopoly in practice but itself a marketplace of confusion in need of more explanation that often reach them through the seed sellers who form an unexpected, emergent community of experts (Soto Laveaga 2009) who are still embedded and capitalize on ties of caste and kinship. For instance, if the seed sellers anticipate an increase in demand of a specific brand of seeds, it is common for them to first sell that brand to their kin and caste members before opening the sale to the regular streams of farmers. After observing and interacting with more than 400 farmers who stopped by to discuss, contemplate, and buy seeds at the seed shops, and adding to anthropologist

Glenn Stone's extensive study of *Bt* cotton in the southern state of Andhra Pradesh where he shows how farmers select seeds largely by following wealthier farmers, I suggest that it is often at the seed shops where these decisions are made, based on a mix of personal experience and the information provided by the seed sellers. Further, along with this complex set of interactions of the farmers with the seed sellers, *Bt* seeds have their own temporality that is often uncertain and haphazard. They are neither a stable or a static category. Most of my respondents--- both farmers and scientists working with the seed companies---- agreed that over a period of more than a decade, the pests have developed resistance to the seeds and there is a significant increase in the use of pesticides in the last few years. This is reflected in the *kind* of *Bt* cotton that is present in the market. Within four years of its release in 2002, the pests became resistant to Bollgard I which was soon replaced by Bollgard II technology. The latter contains two genes, Cry1AC and Cry2AB, that claims stronger protection of the seeds from pest attacks, especially pink and American bollworms. However, during my stay in Durgadaitya, there were increasing reports of the return of pink bollworms in the cotton fields across the country resulting in panic among the farming communities and increase in the use of pesticides by cotton farmers. The prices of *Bt* seeds have come down over the years due to consistent protests by several farming and activist groups over the years that repeatedly showed the connection between debts created by high prices of seeds and farmers' suicides due to crop failure. In the initial years of its commercial release, each packet of *Bt* seeds cost INR 1500-1700, with variations in prices created by state regulations. In 2016, the central government placed a cap on the price of packets to INR. 1000, with the royalty paid to MMB by the India seed companies being INR 49 compared to INR 184 in the previous years. Within the "commodity phase" (Appadurai 1986) of the seeds, they seem to possess a "vitality" (Latour 1996, 2012), "vibrant materiality", or "the capacity…not only to impede or block the will and designs of humans but also to act as quasi agents or forces with trajectories, propensities, or tendencies of their own" (Bennett 2009, viii). Yet, as I have showed so far, the materiality and the temporality of the seeds are inextricably entangled with the practices and decision making around seed choices and the larger political economy and national policies around scientific and technological objects.

Meanwhile, I kept following the path of the question, which one is good this year, that floated around in conversations among older farmers, during interviews, among the sales representatives of different companies, and the numerous farmers dropping by at the seed shops. This question was always asked and contemplated upon about the size of the bolls, yield, resistance to pest but the sum of these parts never conveyed the whole to me, never provided me with a description of what a good seed is, the answer to which I was frantically searching throughout my stay in the village. Until one afternoon when all the work in the fields were halted for the day because of the unbridled rains since morning. I was invited to the *mukhiya's* house for tea. After talking to her for a while, I started speaking with her brother, who has around 7 acres of land and he had planted mostly cotton in his fields the previous season. He had been planting Bindaas seeds for the past few years. While speaking about the process of selecting seeds, the cultivation process, and the everyday uncertainty laced around it, he said, *"Achi beej to phasal ke baad hi pata chalta hai. Agar jo man mein hai waisi hi phasal hui, to chalo beej achi nikli. Achnak se agar kuch idhar udhar nahi hua, to bharosa hota hai. Phir kuch gadbad ho gaya to bas vishwas kho jata hai"* (One can know whether a seed is good or not only after harvest. If the harvest turns out to be as I had had imagined in my heart, then it's good. If there are no unpleasant surprises, it slowly builds trust until it is broken by an unpleasant harvest).

Temporality of the Environment

The porosity of the seeds, bodies, and the soil and virtues, vices, weakness, and strength permeating through them have been written about by scholars in environmental and ecological anthropology. Linda Nash for instance, shows us in "Inescapable Ecologies" how bodies are "intermixed with their environments" (Nash 2006) while charting out the shifting understandings of disease in California's central valley over the 19th and 20th centuries. I encountered statements like people become what they eat (Paxson 2008); or our bodies are weaker these days because of the lack of vigor in hybrid food crops and the soil during several interviews and conversations. The contingencies and exigencies of the environment further exacerbate the already truncated relation between agricultural practices, lives, and the seeds. Scholars working on ecological and environmental studies in South Asia have written about the complex relations between the environmental contingencies and agricultural lives (Gupta 1998, Agarwal and Sivaramakrishnan 2000, Scott and Bhatt 2001, Pandian 2009, Amrith 2013). In cultivating *Bt* seeds, however, the stakes are significantly higher. The time, arrival, and sustained presence of the monsoons take a different dimension in cultivating *Bt* cotton because it demands water supply at more regular intervals than its non-GM predecessors. The roots of *Bt* cotton plants are shorter, which means, neither can the plants draw water from the deep soil, nor can they sustain themselves in the face of the blow of extremely heavy rainfall. *Bt* plants are more *nazuk* or delicate, as several farmers would put it. Further, for the past two years, the attacks by new kinds of pests like white flies have spread over several parts of the cotton producing regions. It is a constant process of trial and error around working with the seeds and building web of relations to understand the everyday changes.

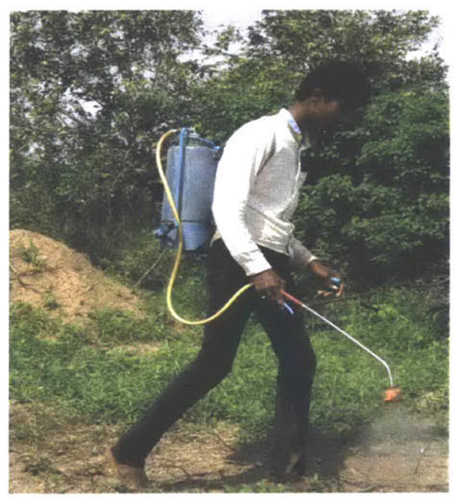
I closely observed Anil *bhaiya's* and Madhorao Ungde's cotton fields. Anil *bhaiya* had planted cotton in around 5 acres and Ungde *kaka* in one and a half acres. By the end of the first week, the newly growing cotton plants in more than half of Anil *bhaiya's* plot were devoured by the herds of monkeys and deer from nearby forests, despite having a night guard stationed in the field. Nobody could explain with certainty the reason behind these increased attacks by animals but several farmers suggested that the buds of flowers of these plants are bigger, juicier, and therefore, more attractive for the animals. He had to immediately plant a few new packets of seeds so that the growth of these new plants was not very different from the older ones. By the end of two weeks, the fields were covered with grass and weeds. I had to get reoriented to the field because it was easy to lose sight of the plants. Groups of women were at work to manually cut the grass and men began spraying the first round of pesticides in the cotton field. Although cultivation of cotton perhaps requires lesser agricultural knowledge and intuition than food crops like rice (Flachs and Stone 2018, Davidson 2016), the use of *Bt* seeds requires more regularized attention and caretaking than its non *Bt* predecessors. For instance, when I was in the field, there was no herbicide in the market that could be applied to weeds without destroying the cotton plants. As a result, the need for women's labor has significantly increased in the past decade, as cutting grass usually falls on women's side of the agricultural division of labor. Ashish and his friend were spraying the pesticide, Odyssey. Each of them were carrying a blue plastic 15 Liters tank on their back equipped with a pump on one side and pipe with a nozzle on the other side that must be around 2 feet long. They were pressing the pump with the right hand and rotating the pipe in half circles to spray the liquid. They were wearing the usual tea shirt, cotton pants, and *chappals* or slippers while spraying. Since my first day of fieldwork, I encountered several disparaging comments from medium and large farmers about how the labor force cannot be trusted anymore and how the laborers only care about money these days unlike even a decade ago when they felt responsible for the owner's fields like their own. The wages, although still meagre, have increased from approximately INR25 for the entire day in 1995 to INR 100 for four hours for women and INR 150 for men for the same time. The relations and politics around emerging labor conditions during the past decade and a half of *Bt* cultivation is a subject of another chapter, but for the scope of the argument presented here, it suffices to say that not only have labor relations around the cultivation of *Bt* cotton become a site for claim making for the laborers, but the texture of attention and alertness that is required at every step of the cultivation process from the time of sowing to spraying pesticides and growth hormones on the plants to harvesting the fiber at the opportune moment, is more intensive that pre-*Bt* hybrids or several other crops cultivated in the region like soybean and lentils.

The "time" of the practices of the farmers, the conditions of the environment, and the stage of the seeds in the cultivation process must be aligned, re-adjusted, and tinkered with throughout the cultivation process. As a farmer, Nangorao Meghuji, with 5 acres of land pointed out, "during our fathers' and grandfathers' times, we used to start sowing during *Mirukh Nakshtra*. If one sowed seeds during this *Nakshatra*, one knew when to expect the harvest, how much to expect. This would usually be the beginning of June. The harvest would usually be guaranteed if we could begin during Mirukh. The fiber came faster if we sowed during Mirukh. But now-a -days, there are no rains during Mirukh. We wait for Ardhara Nakshatra, which comes after ten-fifteen days. If there is no monsoon even then, then we wait for it to come. We listen to the radio, watch television, read newspapers. Some say it'll arrive on the 28^{th}, others say on the 30^{th}. One has to wait…" In Durgadaitya, most farmers have at least basic irrigation facilities. After ploughing and preparing the fields for cotton cultivation, the seeds are sown for the for the first time around 2-3 days of the arrival of the monsoons. I noticed that most of the fields had drip irrigation, where water runs through pipes that are positioned across the fields and gets sprayed at points with regular gaps between them. The seeds are strategically planted next to the apertures in the pipes so that they can get directly sprinkled without the loss of water through evaporation. Although most of the seeds sprout with the help of water through this irrigation mechanism, they cannot sustain themselves without the monsoons. However, it is critical to plant the seeds right before the monsoons or on the first few days when the rain is still scanty. If the seeds are planted in the middle of heavy rains, the entire field, along with the newly sown seeds get completely washed away, requiring the farmer to repeat the entire process all over again.

The knowledge around the use of pesticides and herbicides that are intrinsically linked with the cultivation of *Bt* cotton, is often shrouded in confusion. There are emerging predicaments every season that are difficult to anticipate and control. The seed shops, once again, become the center of solving the everyday crises and problems that the farmers face on a regular basis. When I asked Ungde *Kaka* about how does he detect a pest attack or decide on the right moment to spray pesticides, he said, the moment he sees that there are flies on the leaves or the leaves are curling up, he plucks a leaf and takes it to the shop to show them. They recommend the kind and dosage of pesticide necessary to solve that problem. I encountered several complaints from farmers while sitting at the seed shops during the phase after planting the seeds. One of the central themes of confusion was around measuring the quantities of pesticides that the farmers needed for the spray. I noticed that the people in the seed shops would always write the dosage on the bottle. I asked them why did they do that because the company already mentions it at the back of the packet. The problem with the stipulation by the company is, they state the amount that is needed for one hectare (around 2.5 acres) but farmers find it hard to calculate for the number of acres that they have. Further, everyone uses lesser water in the fields cut down on labor, so the seed shops increase the dosage accordingly. As Ashish Ghive pointed out, *"100 liter paani per care. Hand pump: 15 liter ka hota hai zyada tar. To 15 divided by 100: 7-8 pump hone chahiye. Lekin customer kitna karte hai:*

panch hi karte hai. To utna liquid kam hua na. doosra point yeh bhi hai: company jo research karti hai, wahan ka temperature kuch alag reheat hai. Yahan ka alag reheat hai. Doses bada na parta hai. Company ke recommendation mein sirf Paani ka matra reheat hai. Jaise 2.5 acre ke liye company likhta nahi kitna dalna parta hai" (The company recommends 100 liters of water per acre. The pumps usually carry 15 liters at a time. So, ideally one should spray 7-8 pumps of water but farmers do not spray more than five. So we have to adjust the dosage accordingly. Another point is, when the companies do their research, the temperature there is different. Here, it is different. That matters as well).

The farmers try to follow the instructions, but the practice of adding "more" than what is suggested, is quite common in the fields. Expectedly, the seed sellers often prescribe more than just the cure for the problem. For instance, when Anil *bhaiya* went with a leaf from his field because he suspected that it was infested with white flies, they advised him to buy "sticker", which is a chemical product used before spraying pesticides so that the plant body and the roots are more receptive to the pesticides. "If you can afford, you always feel the more you spend, the better harvest you will receive. It is like eating in a restaurant. Even if the food is not necessarily that delicious, you feel that you have eaten well if you spend more money", explained Anil *bhaiya* while measuring the dosage of pesticides one afternoon. This idea of more the better would always be contrasted with unsettling the balance: *"santulan kho gaya" hai*, was a phrase that resonated several times during conversations. The awe of higher yield of *Bt* cotton, albeit mellowed in the past four to five years, is often linked with this new "technology", the seeds and the additional routine of fertilizers, pesticides, herbicides, and growth enhancers that the farmers constantly use in the fields. Most farmers have a very good sense of what the soil needs, when. Or the times that they look at the sky and correctly predict the arrival of the rains are surprisingly accurate. But the pest attacks that have consistently increased over the past few years and although their arrival is unanticipated once they hit the field, they can destroy the entire field in a matter of a few days. The eventuality, contingency of the environment forge a sense of incomprehensibility around the meaning of seeds or agriculture itself.



(Left) Anil *bhaiya* preparing the pesticides as Ashish and his friend look on. (Right) A young man spraying pesticides in the cotton fields.

In the otherwise repetitive agricultural practices, these everyday chance encounters, unpredictable occurrences, and unwelcome guests like white flies and pink bollworms act as differentials in this "interaction between a place, a time and an expenditure of energy" or "rhythm" (Lefebvre 2004: 15). Recent STS scholarship on bio-economy reflects on how value is created through the creation and use of biological materials and knowledge (Wldby 2000, Rose 2002, Sunder Rajan 2006, 2012, Cooper 2008, Goldstein and Johnson 2015). Adding the value of materiality of seeds to their commodity phase, I argue that one needs to incorporate this constant element of contingency and chance in the valuation of the seed or evaluation of the good seed as well as, comprehending the transforming agricultural practices and experiences. Highlighting the value of chance into the center of the meaning of GM seeds make them intrinsically "unfinished" (Paxson 2012) and connects agrarian lives with environmental conditions that are often delinked in South Asia (Agarwal and Siva Ramakrishnan 2000: 2). It further shifts the focus of narratives of agricultural biotechnology at the national scale from increased yield of cotton production in the country to the everyday difficulties of farmers rather than only taking these experiences into account when the situation is dire like the large scale farmers' suicides.

Temporality of the Market

"There was one big market in Khamgaon during my grandfather's time. He would fill 20-25 bullock carts with sacks of kapas or unginned cotton. This is before Swaraaj or independence. The price would open sharp at noon. There would be several merchants.

And there would be middlemen or *dalal* who would inspect our cotton and selectively show them to the merchants. They would be usually known to the farmers through years of interaction or through ties of kinship. The merchants would shout out the prices to the farmers. The merchant with the highest price would end up buying the cotton. The commission agents and the middlemen would then settle the nitty gritty of the deal, pay them the money. They would get silver coins with the queen's bust embossed on them."

---Bhimrao Raipure, a farmer in his 70s with medium landholding.

Based on the The Maharashtra Raw Cotton (Procurement, Processing and Marketing) Act of 1971, Maharashtra Cotton Monopoly Scheme was started by the state government. This was one of the few legislations that had a 'sunset' provision which meant that it was an act for a certain period of time: " The government of Maharashtra has decided that all trade in raw cotton should be carried on by the state for a certain time, and for that purpose for acquiring 'kapas' (unginned cotton) from growers and other persons having stocks of cotton, getting it ginned and pressed into bales, selling it in that form to consumers and others on behalf of tenderers and paying compensation to the tenderers: and provide for matters relating to the matters aforesaid." In the beginning, the scheme was scheduled to be continued until 1980. One of the central strengths of the scheme was the 'guaranteed price' that was determined by the state government in consultation with the central government towards the beginning of every harvest season. Usually, the guaranteed price would be well above the cost price that the farmers would incur during a given season. They would be paid around eighty percent of the guaranteed price for the cotton tendered by him at the collection center or in two instalments soon afterwards. The remaining amount would be paid within three months after the closing of the season. Other than the guaranteed price, another important feature of the scheme was the settlement of the 'final price' that would be decided soon after 30th September. This final price would be settled and notified in the Official Gazette based on the price at which bales of cotton, ginned cotton, *kapas*, cotton seed, and cotton waste would be sold that season, the left over stocks, and the cost incurred for handling all of the processes. If the guaranteed price exceeded the final price, there was a fund known as the 'Price Fluctuation Fund' that was set up to fill the deficit and if the final price exceeded the guaranteed price, seventy five percent of the difference was paid to the tenderer as the additional price.

This scheme acted as a safety net for the farmers even if the *kapas* would be destroyed by the rains or yellowed due to storage. The provision in the scheme that cotton grown in the state could only be sold within the state border sometimes worked as a blessing, especially if the harvest was not outstanding during a particular season. The disadvantage of that was the higher prices that were offered in the neighboring state of Gujarat that has historically been a center of trade in raw cotton as well as textiles.

Further, the time taken by the Federation that controlled the entire system to process all payments was sometimes as long as half a year that would make it very difficult for the farming communities to prepare their fields for the upcoming winter season. The scheme was in effect until 1999 when buying and selling were taken over by networks of private businessmen, giving rise to the everyday fluctuations of price and the added value of trust. Sometimes the price of un-ginned cotton fluctuates 4-5 times within the span of a single day. This gets particularly precarious for farmers who do not have the space to store the un-ginned fiber for a later time when the price is higher. After working through the chaos of the number of *Bt* seeds available and the anticipations around the environment, the shifty, elusive temporality of the market, defers the value or meaning of what a good seed is. Navigating these everyday contingencies, a farmer described that for him, a good seed is the one which is familiar to him, which he understands, and knows what to expect from. He certainly did not consider *Bt* cotton as good for cultivation, but more importantly, as a means of livelihood.

Anthropology and philosophy have attempted to understand the relation between time and temporality for over a century. If temporality is the lived experience of the clock time (Couzens 1999), then the relation between time and temporality is understood in a few different ways. In *Critique of Pure Reason*, Kant writes that time cannot be perceived because perception is constantly changing whereas time is not. Time is a framework for all perception, including temporality. In western philosophy, Kant's conception of time is a first break from metaphysics where the focus was on understanding the nature of time itself towards a phenomenological approach where time is linked with perception for the first time. In his analysis, time, in the Newtonian sense, still comes before human perception of it. Martin Heidegger, in *Being and Time*, inverts Kant's argument by showing how the philosopher can reach objective time through the qualitative temporality whereas it is not possible to understand temporality if one begins from objective time. But how does one understand temporality? Edmund Husserl, in *On the Phenomenology of the Consciousness of Internal Time* explains the content of temporality through the concepts of "duration" and "intentionality". He describes duration as the qualitative aspect of temporality and intentionality as the way in which the specific perception of a subject is directed towards a particular object. So the same object, the moon, for example, is perceived by different people as bright, or half-full, or in the horizon. He explains the coming together of duration and intentionality through notes in a melody. A melody is composed of several notes, and even when a person hears the same note over time, the notes that have been played are "retained", that leads to "sinking" into the past. This "primary memory" corresponds to the "Now" every time the note is played, with intentionality getting interlaced with duration to produce a particular temporality.

Henri Lefebvre, in *Rhythmanalysis: Space, Time, and Everyday Life,* works with a similar notion of melody, but adds two other categories, "harmony" and "rhythm" while relating music with everyday life—an analysis which is more relevant for this chapter. Lefebvre considers these three elements of music essential for understanding time. Like Husserl, he considers melody as a sequence of notes in temporal succession, harmony being notes sounding at the same time, and rhythm being the "placement of notes and their relative lengths" (Lefebvre 2004: xi). Transposing this concept of the rhythm from music, he studies the relation between social and biological rhythms as they get manifested through the human body. The cyclical rhythms of the environment and the body--- the rising of the sun, the seasons, waking up, sleeping--- get interlinked with the linear rhythms of the society like working. And, the quintessential aspect of Lefebvre's rhythm is "repetition in a movement, but not just any repetition. The monotonous return of the same, self identical, noise no more forms a rhythm than does some moving object on its trajectory, for example a falling stone; though our ears and without doubt our brains tend to introduce a rhythm into every repetition, even completely linear ones. For there to be rhythm, strong times and weak times, which return in accordance with a rule or law--- long and short times, recurring in a recognizable way, stops, silences, blanks, resumptions and intervals in accordance with regularity, must appear in a movement. Rhythm therefore brings with it differentiated time, a qualified duration" (Lefebvre 2004: 78).

Lefebvre's concept of duration as differentiated time constructed by repetition, or even time itself, are different from the way Henri Hubert, a sociologist and archaeologist and a long term collaborator with Marcel Mauss, wrote about time, duration, and rhythm in *An essay on Time: A Brief study of the Representation of Time in Religion and Magic.* For religion and magic, he writes, "the object of a calendar is not to measure time but endow it with rhythm. Thus, on the one hand, rites are necessarily distributed in a time divided by fixed, regularly spaced points. On the other hand, religious representations, besides assigning limits to divine eternities, and allowing Gods to die, also assume the time in which durations of every types elapse, especially divine ones to have a rhythm" (Hubert 1999: 50). For example, princesses who are lost in a castle in certain myths are freed at a from a magic spell at a magic moment that occurs at intervals. So, mythic eternities are essentially periodic. He then relates this duration with time to show their incommensurability. One of the stories he uses to show this incommensurability is that of a Macedonian hero who takes three years to descend to the antipodes and twelve years to climb back on, without spending much time there, but remained outside of the country for thirty years. This kind of contradiction doesn't surprise him. He argues that it through contradiction like these that the antimony between divisible time and the indivisible sacred, "which seeds itself within time" are reconciled (Hubert 1999: 50). For societies that consider time as duration, the calendar dates interrupt that duration, often in the form of rites. In Hubert's description of duration of the sacred, therefore, temporality, albeit mythical, is placed as the starting point of reaching and understanding time.

In Hinduism, time and time-consciousness is all pervasive and an illusion at the same time. Questions and conceptions around time have been recurrently deliberated upon in texts like the *Vedas*, the *Upanishads,* the *Bhagavad Gita,* the *Puranas* and epics like *Mahabharata* and *Ramayana*. The concept of time is intrinsically linked with the lively ethos of the self and the world present in Hinduism. As Balslev point out: "At the outset it must be mentioned that two of the most important ideas about the self and the world that have exerted decisive influence on all Hindu thinking are: the idea of *anadi-samsara*--- that no absolute beginning can be attributed to the world process and b) the idea that moksa, the soteriological goal, is not possible without 'knowledge of the self' (*atma-vidya*)" (Balslev 1993: 164).

Time, or *Kala,* holds the self and the world within itself. the Atharva Veda portrays time as the all powerful deity, as the creator, sustainer, and destroyer of the universe:

---- *Kalah Kalyatam aham---*

'Of Calculators I am Time' x/32

----- *Kalo'smi, lokaksayakrt----*

'Time am I world destroying' xi/32

------ *Aham Evaksayah kalo----*

'I also am imperishable time' x/33[5]

There are several references of time in the Upanishads where it is referred as *kala* and *akala*--- the measurable and immesurable time. It is through the immeasurable that it folds the concepts of the self and the world within itself--- time that is both overarching and non existent, like the lack of beginning and end of the self and the world. Another connotation of *kala* is duration, but unlike Lefebvre's duration, it is characterized by repeated process of creation and dissolution, which is different from the notion of "cyclical time" (Balslev and Mohanty: 1993). If the fulcrum of Lefebvre's duration is rhythm and repetition through cycles, the core of *kala* as duration is constant *change*. If time was understood as duration in the form of repetition that linked the lunar calendar with the moment of sowing and harvesting, it is now replaced by an idea of duration determined by the alignment of the seeds and the monsoons, which is often at odds with rituals and festivals of the lunar calendar that was initially based on cycles of harvest. Time in the village, is then, both repetition and change. If the value of the good seed is constantly deferred because of the braided temporalities, there is also a braided notion of time that is emerging in the village because of the coming of *Bt* seeds.

[5] For more references, read Hymns of the Atharva Veda, translated by M. Bloomfield in sacred Books of the East, edited by F. Maxmuller, Vol. XLII

In Logic of Practice, Pierre Bourdieu writes, "Practice unfolds in time and it has all the correlative properties such as irreversibility, that synchronization destroys. Its temporal structure, that is, its rhythm, its tempo, and above all its directionality, is constitutive of its meaning." In this case, the seeds unfold in time. Instead of cyclical and linear progressions, these three temporalities are locked in a braid--- separate yet intertwined, interlaced beyond separation. The search for the "good seed" or the "best seed this season" contains an implicit desire of a fertile harvest and an increased price than what one received last harvest but the value of a good seed often slips and slides through these temporalities never to be realized.

Not only is the value of GM seeds based on yield is deferred and challenged because of these interlocked temporalities, I suggest, that the braided temporalities give rise to a different notion of social time in the village which is more agile, adventitious, and haphazard. Time and its various kinsfolk like duration, rhythm, or measure have an intimate and significant relation with agricultural lives and livelihoods. Following the lunar calendar to perform the various agricultural tasks like sowing, nurturing, and harvesting is often based on the belief that the moon controls moisture. The period right before the full moon is considered wet and particularly favorable for planting seeds especially in regions with drier climate and soil. Emile Durkheim was one of the first few anthropologists who made a deliberate attempt to connect abstract time with temporality, or experiences of time, that was hitherto discussed mainly in philosophy. He makes this connection through his concept of the "social time"--- "the calendar expresses the rhythm of collective activities, while at the same time its function is to assure their regularity.. what the category proof time expresses is the common time for the group, the social time" (Durkheim 1982: 8). Along with this slow change of the social time that is increasingly becoming more fluctuating, the three intersecting temporalities lead to "cascades, changes, and implications" where the value of a technology like GM seeds can rarely be judged through a straight forward cost-benefit analysis (Fischer, 2018: 4). The rhythm, the ruse, and the rage of the *Bt* seed itself, the environment, and the market lead to checkered and inter-threaded experiences by the framers and makes GM seeds an intrinsically unfinished commodity.

Chapter 3

Seed Matters

"Breeding is a classic example of a practice that is both art and science. The experience of the breeder in selecting the varieties to make crosses is as important as having the vision and imagination of the perfect hybrid".

Mahantesh Satihal, Principal Cotton Breeder, Nuziveedu Seeds

"We want to deliver the best seeds to our farmers: the ones that germinate well in varying weather conditions, yield more, and are resistant to pests."

M Satyaprasad, Lead Biotechnologist, NSL

After waiting for several weeks to get access to Nuziveedu Seeds Ltd., and learning to embrace awaiting as the beloved of fieldwork's *doing*, I reached Hyderabad city on a pleasant autumn day in mid-November. Hyderabad is the capital of the newly formed southern Indian state of Telengana which was carved out of its parent state, Andhra Pradesh, in 2014. Unlike in several other Indian cities like Delhi where the geographies of the old and the new were distinctively marked almost a century ago, in Hyderabad, the new city has emerged over the past decade on the western side of the old, separated by the Musi river. With names like Cyberabad and Hi-Tech city, the new geography and architecture are a stark contrast to the old city that was built by Muhammed Quli Qutab Shah in 1591 and was a princely state ruled by the Nizams of Hyderabad until a year after India's independence from the colonial rule in 1947.

Nuziveedu Seeds Ltd., a leading producer of cotton hybrids for the past four decades in the country with over 5 million users this past year, is located in Kandlakoya village in Medchal, around 30 Kilometers north of Hyderabad city. I had already reserved a taxi in advance through the company because the location is out of coverage area for most taxi services. Following a straight way to the north from the Begumpet airport in Hyderabad, I crossed dusty highways and miles of disorderly traffic to reach the Nuziveedu Seeds Headquarters in Medchal. Like most agricultural companies in India, the campus--- with the office building, quarters for employees, and research plots--- is set up away from the main city, amidst a stretch of arid land with a few other industries around. The office building, with its white, yellow, and orange tiles and slightly tinted windows is an archetype of the infrastructure that has been sweeping the city over the past decade.

"Doing ethnography", wrote the master craftsman, Clifford Geertz, "is like trying to read (in the sense of "construct a reading of") a manuscript--- foreign, faded, full of ellipses, incoherencies, suspicious emendations, and tendentious commentaries, but written not in conventionalized graphs of sound but in transient examples of shaped behavior" (Geertz 1973, 10). Instead of trying to decipher the layered meanings of a "burlesqued wink", I was curious to read this thing, the seed, that everyone was tinkering with, gossiping about, and contemplating on. I wanted to inscribe palimpsests of meanings on the seed--- in its amorphousness, distinctiveness, entirety, and unfinishedness--- through the practices of the communities of breeders, biotechnologists, and lab assistants whom I spent most of my time with. The chapter asks the question, how did GM seeds come to acquire a myopic yet disproportionate focus in both scholarship and public discourse around agricultural biotechnology in the past decade? In the writings of economists, anthropologists, or natural scientists, as well as in the news and social media, the discussions have often been based on *Bt* cotton seeds themselves. Whether the seeds are considered intrinsically good in comparison with the earlier cotton hybrids, or seen as objects that are breeding uncertainty among the farming communities, they often emerge from an idea of boundedness and potency, whether good or bad, of the seeds. The chapter reflects on the *process* through which the seeds acquire their thing-ness. By closely following the practices of the breeding community and the biotechnologists/ people working in the biotechnology lab and the Seed Testing Laboratory (STL), I suggest that it is within the space of the labs, through the practices of the scientists, and their experience with time, that the seeds become materially and epistemologically stable and bounded. It is here that the "good seed" is created. For the breeding communities, the seed is unfolding, unbounded, and constantly emerging through the interplay of prolonged time, breeding practices, and various contingencies. However, it is the experience and understandings of the scientists and the epistemic culture of biotechnology that get circumscribed once the seeds leave the premises of the company.

The chapter begins with situating the practices of breeding and seed testing within the larger space of the company. Through descriptions of people, structures of feelings (Williams 1954), and conversations around science, biotechnology, and the nation, this section narrates the double bind or multiple positions that institutions like the seed companies or the state often come to inhabit around the question of agricultural biotechnology. It then moves on to the sections that show how the practices of the different communities and their experiences of time inscribe the seeds with different meanings. The last section follows a recent High Court order that pronounced its judgement in favor of NSL in a case where Monsanto had sued NSL for failing to pay the trait value. By reflecting on specific terms and phrases used by the court, the section revisits the position of double bind, this time of the state, and suggests that with the pronouncement of this ruling, the question shifts from what is *good* to what is *right*, creating a distinctive ethical plateau in the face of recent entanglements around agricultural biotechnology.

Nuziveedu Seeds Limited

The first few weeks went by in getting familiar with the divisions in the company and the implicit hierarchies within them, introducing myself to the breeders as well as the lab scientists, and reading biology text books during the evenings when I would return to my room in the quarter. I realized early on that understanding terms and phrases like "heterosis", "totepotency", "gene-environment interaction", "pedigree method of breeding", was the rite of passage without crossing which I could never hope to acquire the status of a researcher whom people would want to engage with. The lead biotechnologist, M Satyaprasad, and the principal rice breeder, Suraramakrishna, graciously volunteered to give me lessons on biotechnology and plant breeding during the first month of my stay at the company.

M Satyaprasad is the head of the entire biotechnology lab at NSL. He was significant for my research in several ways. Pragmatically, he had to grant me permission for any access that I wanted in the biotechnology lab. His passion for teaching as a way of being in the company granted me hours of conversations with him that indeed worked as the scaffolding for comprehending the assemblages of work that is carried out in the lab. But most, importantly, for me, he represented the juxtaposition of doubleness, or even the multiplicity of ideas and ethics that I often encountered in the larger space of the company. The evocation of science and religion, technologies in the lab and those in farmers' fields, the east and the west were some of those binaries that recurrently appeared in my conversations with people in the company. Not only were there references to "a different modernity" (Prakash 1998) that India should ideally adopt where science is not an end in itself but a means towards ameliorating the human condition (Nehru 1946), there were simultaneous critiques of the "productive" in its broadest sense. Whether it is unleashing the highest productivity of land or earning the maximum profit by selling the seeds, I encountered the phrase "loss of equilibrium" several times during my fieldwork at the company as well as the village. The need for a reflective interlude in the long run of modernization in agriculture that began with the Green Revolution was an underlying theme in several conversations. These fusions of worldviews attributed a distinctive characteristic to the company—it is both profit making and paternalistic at the same time. For instance, the allocation of resources, especially in cotton research in the company, is heavily biased towards the breeders because they ultimately bring in the most profit for the company whereas the staff in the labs sometimes don't even have a high school degree. They are hired for quite low salaries. At the same time, I came across a few employees who have been working with the company for decades and they still receive a salary although they can hardly work because of their old age.

After completing his PhD from Institute of Ecological Genetics, Academy of Sciences, Kishinev, USSR, in the 1980s, M Satya Prasad was a post-doctoral fellow at institutes in Russia, Taiwan, and India. After traveling and living among several different communities in the world, he proudly proclaims himself as a nationalist and a "die hard lover of his country and science". He would often comment, "It is better to clean toilets in my own country than cleaning them abroad", during many conversations that we had on agriculture, Indian science, the future of biotechnology, and the role of the state in promoting a certain kind of science in the country. The very next moment, he would underscore the efficiency of several western countries and the lack of interference of green, red, blue parties in matters of science. After passionately talking about the promise of "Science", he would underline that the final word always lies with "God". When I asked him what he means by that, he mentioned that any nation might have innumerable technologies but the one that stays on or should stay on is the one that does good for humanity. I noticed transpositions of these juxtapositions in the space of the company as well--- every room in the laboratory, the common corridors of the office, and the entire building was punctuated with altars of Hindu deities, primarily, Lord Ganesha, the god of beginnings, and Lakshmi, the goddess of prosperity and wealth. Each morning would begin with a priest chanting mantras and performing a few brief rituals in the main biotechnology lab. Being the Chief Scientist (Biotechnology) and working with NSL for almost a decade, Satyaprasad is a trusted and significant voice in the company which is paired with his avuncular behavior with not only his team members but towards scientists of the entire biotechnology laboratory. With the average age of 25-35 of most of the men and women working in the lab, I often noticed he would explain processes of conducting tests or point out their mistakes by mildly scolding them and immediately cracking jokes.

He was vocal about his mixed feelings about *Bt* technology as well. During his upbeat moments, he would reiterate, "we need global solutions to local problems of draught, severe lack of water resources in most areas in our country". Simultaneously, being skeptical of the technology, he would explain, "All life creatures, we all evolve over time. Even in humans, we might look the same for centuries but there are systemic changes rather than anatomical change: the mind evolves over time. There is an equilibrium in nature and it's a problem if it gets skewed. The most critical problem is, if there is a problem, we try to eliminate it instead of controlling it. It is next to impossible to destroy an entire species. The other living creature also evolves. Before *Bt* technology, we were spraying *Bt* pesticides. Now we have introduced it in the system. Frequency to mutation: 10(to the power -7): If one insect becomes resistant, it enters the entire population. Take, for example, drug resistant TB: instead of prescribing one antibiotic, doctors are prescribing cocktails. Now we are only left with damage control measures. BGII has failed. We need a new poison." A similar skepticism was expressed by the CEO of the company, Prabhakar Rao during our conversation: "When I was your age, I used to strongly believe that modern agricultural technology is the answer to the crisis in agriculture in our country. But now I realize that technology has its own limits. Perhaps it is not such a bad idea to look at traditional agricultural practices to find answers to the pressing needs of our times."

There would rarely be any conversation with the scientists that would not read GM seeds as an intertext of the Green Revolution, which was adopted full-fledged in most parts of the country by the 1970s, especially in the northern, wheat producing regions of Punjab and Haryana. The Green Revolution was a paradigm shift in agriculture because it introduced hybrids in most crops in the country, especially grains like wheat. Instead of reproducing the same plant every season by planting seeds from that plant, hybrids were made by breeders by selecting two parents, often from different species, that looked promising and manually making crosses between them so that the resulting hybrid plants carry the traits of both the parents. Along with scientists in the lab who were more reflective and critical about the GM technology, there were others who truly valued the promissory nature of the *Bt* technology. They pointed out the ways in which higher yielding, dwarf, hybrids of food crops, especially wheat, made India self-sufficient in agricultural production and elevated the status of the country at the world stage. If introduction of hybrids was the fulcrum around which the promise of higher yield was weaved during the Green Revolution, genetically modifying the seeds seem like the next logical step in manipulating the seed for purposes of higher yields and more effective resistance to pests. Nuziveedu Seeds Ltd. is one of the 42 Indian seed companies that Monsanto Mahyco Biotech (MMB) has sub-licensed Bollgard I and Bollgard II technology to. Monsanto has patents over these technologies. Each Indian company (sublicensee) purchases the technology by paying a lump sum to Monsanto and further paying a trait value every year which is a certain amount of money against the sale f each packet of seeds containing the technology. These companies use several breeding techniques to make crosses between these genetically modified seeds and the germplasm that the companies have been building for several decades. Bollgard I contained one gene, Cry1AC, whereas Bollgard II contains Cry1AC and Cry2AB genes. Most of the cotton seeds available in the market is made with the Bollgard II technology.

The articulations of the mutually constitutive relation between plants, seeds, soil, and bodies is pervasive in India (Gupta 1998). Phrases like the health of a plant (or children) depends on the vigor of the seed or you become what you eat emerged several times in the village as well as the company. In vegetarian households, women often follow vegetarianism more strictly than men. Other than the reason of purity/pollution where meat is considered polluting, women recurrently reflect on the notion of "goon" or inherent characteristics, whether virtuous or vicious, of what one eats. Vegetables are considered cooler than meat and therefore, more suitable for the bodies consuming them. Meat produces heat in the body and makes a person prone to vices. Older men in the village often compared the hybrid food crops with their non-hybrid predecessors as weaker *("takat kam hai isme"),* or insipid *("phika hai")*. They explained that the soil in which they cultivate crops has become lighter and drier over the decades because of increased use of fertilizers and pesticides. It is left with very little strength can be imbibed in the seed and the plant that grows from it. In most of these conversations, the seed is considered as potent and vigorous. During my conversations with biotechnologists and breeders in the seed company, the potency of the seed came up as well, not in the sense of "goon" or inherent qualities of the seed, but in terms of the capacity to yield more. The superiority of the seeds because of their potential of higher productivity was underscored as a virtue in most of the conversations.

In both these narratives of the seed as the seat of qualitative virtues or quantitative possibilities, the seeds seem to be possessing a "vitality", "vibrant materiality", or "the capacity…not only to impede or block the will and designs of humans but also to act as quasi agents or forces with trajectories, propensities, or tendencies of their own." (Bennett 2009: viii). Inspired by the vitalist traditions of Epicurus, Nietzsche, Spinoza, and more recent scholarship of Gilles Deluze and Feliz Guattari who argue that "vitality is immanent in matter-energy" (Deluze and Guattari 1987, 351), Jane Bennett attempts to "paint a positive ontology of vibrant matter, which stretches received concepts of agency, action, and freedom sometimes to the breaking point…. To sketch a style of political analysis that can better account for the contributions of non human actants" (Bennet 2009, x). Critiquing the preeminence given to the "human intentional individual actor" (Latour 1996, 373) over the mere behavior in social theory following the Anglo-Saxon tradition, a school of thinkers including Michelle Callon, Bruno Latour, John Law have replaced the word "actor" with "actant" that can be "anything provided it is granted to be the source of an action" (Latour 1996: 373). One of the characteristics of actants is that they are constantly moving, transforming. They are not fixed. They are "circulating objects undergoing trials, and their stability, continuity, isotopy has to be obtained by other actions and other trials" (Latour 1996: 374). The actants can be humans, non humans, things, animals, species--- anything that is a source of action. In Pandora's Hope, for instance, Bruno Latour investigates the strange phenomenon where in an Amazonian rainforest, scientists spot rows of trees that are typical of the savanna. The peculiarity of the phenomenon lies in the fact that rainforest and savannah are different ecosystems with particularly distinct soils--- savanna has porous soil with adequate drainage of water. The rainforest in Amazon, on the other hand, has clayey soil. The group of scientists studying this phenomenon find that worms that had assembled at the border were producing aluminum that was transforming the silica of the savanna into clay. They conclude that the forest was moving towards the savanna. Narrating this as the classic example of actants transforming the entire ecosystem, Latour writes about "translation" of things in the world/ matter and form/word on paper and the fluid relation between them. For instance, the vast stretch of soil and the different kinds of soil subsumed within that vast stretch is made legible by the scientists by first, collecting samples in a pedocomparator and then using the universally accepted Munsell Code to match the color of the sample with a code. The soil becomes a code and becomes soil again in this narrative.

The *Bt* seed could be read as the classic case of an actant--- its lively matter, its potency is revered; it conjures fierce debates across the entire nation; it spins unbounded promise for the future of agriculture. During conversations, especially with biotechnologists, the Bt seed or any seed, did seem like possessing vital matter, a power to change the lives of those who are involved with them. The recurrent narratives of how the high yielding wheat hybrids made India self-sufficient in food grain production in the 1970s almost took the form of a technological deterministic story. In this direction of conversations, *Bt* seeds are actants that not only have been successful in catalyzing fierce debates around the question of whether genetic engineering should be introduced in food crops but have also fortified and stabilized the entire field of agricultural biotechnology and speculations about agricultural futures around itself. In fact, instead of the seed being an actant in a striated, fibrous, capillary assemblage of networks consisting of human and non human actants, the seed is the fulcrum that drives the agricultural biotechnology landscape. But I find this explanation inadequate when I begin to understand the work of different communities, especially the breeders, within the company. As opposed to the Durkheimian notion of the society where the whole is bigger than the sum of its parts, Latour contends that the parts are sometimes even bigger than the whole (Latour 2012). But what this conception excludes is the multiplicity of *meanings* that different communities transpose on to the seeds as they emerge from specific practices of labor and work, and experiences of time. Even within the space of the company, the seed is polysemous, fractal (Comaroff 2012). Instead of stopping at considering the seed as potent and potential, the chapter unfolds the practices of communities in three locations--- the breeding fields, the biotechnology laboratory, and the seed testing laboratory, and shows *how* potentiality gets constructed. The scientific communities in these three locations work with different stages of the seed. The work of the breeders encompasses the longer life stage of the transformation of the seed into plants with desired phenotypic and genotypic characteristics whereas communities working in the laboratories tinker with the seeds either by initiating its rupture (at the biotechnology lab to test whether the seeds have GM traits) or by setting in motion the germination process where they observe the sprouting of the seedling in the seed testing laboratory. Further, the breeders understand the seed as a *process* that unfolds in time whereas the communities working in the laboratories consider the seed as a bounded *object* that holds the promise and the potential of higher yield or being successful in resisting pests. The seed then *becomes* an actant within the space of the laboratory and once we reflect on the process of its becoming, it ceases to be *only* matter that holds the capacity to transform other things. It indeed becomes multiple. The seed acquires its meanings or rather breaks into multiple meanings at these interstices and intersections of materialities, works, contingencies, and practices of different communities within the company.

Reading the *Bt* cotton seed as an actant without unfurling its becoming also forecloses the question, what is at stake when *B*t seeds are considered as parts that are larger than the whole? Who takes responsibility if this lively matter falls short of its promise and possibility? There was often a particularity in the way in which the scientific community in the company placed GM seeds in narrating trajectories of progress and development in post-independence India. And, that was, the constant movement between the GM technology being unprecedented and useful and it is the lack of proper use that determines its efficacy for the larger society, as opposed to the technology itself being flawed and unsustainable in the long run. To explain the former point, I came across the example of cellular phones repeatedly. "You can watch movies all day on your phone instead of working or you can get weather updates and latest information on agriculture through the cell phone", pointed out SP several times during our conversations. In every 450 Grams of *Bt* seeds, there is a packet of 150 grams of non *Bt* seeds that everyone in the company termed as "refugia". The ideal method is to plant these non *Bt* seeds around the *Bt* fields so that if the pests attack, they destroy the outer non *Bt* area keeping the inner field safe. But I saw most of the farmers simply discard this extra packet of non *Bt* seeds because in their already small acreage, there is no space for superfluity. They plant *Bt* seeds across the entire length and breadth of the fields. The decreasing efficacy of the *Bt* technology because of its improper use was juxtaposed with the idea that the GM technology itself is problematic because of the mutation that take place in any organism due to environmental changes, genetic modification to resist pest attacks, in this case. The failure of BG I and eventually BG II would often lead to questions of whether science should solely advance knowledge or the social good as well.

This contradiction of juxtaposing these two ideas was often interlaced with another contradiction: the farming communities being the repository of agricultural knowledge and the best judge of the value of a particular technology as opposed to their inability to judge, stemming from their lack of literacy. I noticed that the biotechnologists, more than the breeders, repeated the impossibility of explaining how the *Bt* technology works to the farmers because of the lack of formal education among most farmers in the country. This contradiction rests on the plurality of "epistemic cultures" (Knorr Cetina 1999) and forms of knowledge on the one hand, and the hegemony of a certain form of biotechnology that is based on the preference of polymeraise chain reaction over other methods on the other, or what some scholars have termed as the "STS of not seeing" (Bonneuil, Foyer, and Wyn 2014). This was more prevalent among the biotechnologists than the breeders. And, this stems from the difference in practice of these two communities and their treatment and experience of/ with time that unfold opposing ideas and acceptances of "non-knowledge" (Boschen 2006). "The first dimension (of non knowledge) refers to knowledge of non knowledge, which spreads between full awareness of non knowledge (we know what we don't know) and complete unawareness ("unknown unknowns"), write Boschen et al. Writing about the difference between molecular biologists and ecologists in accepting and understanding non knowledge, they further write, "if experiments fail to expose unforeseen results, molecular biologists usually do not explore the causes any further, but vary the conditions of the experiment until the expected type of outcome emerges. To refer to this heuristic strategy, Knorr Cetina has coined the term "semi-blind variation" (Knorr Cetina 2010). She argues that this should not be interpreted as a sign of epistemic sloppiness, but as a requirement of the specific research fields and objects of molecular biology.

This view of the technology as an object was very different from the way in which breeders spoke about GM seed or biotechnology. Although there were multiple occasions when the scientists would relate seeds with how they are being used in the field, the irrigation facilities available for farmers, and agricultural practices, most of them seemed convinced that the tests that are conducted in the laboratory endow the seeds with a stamp of certainty which is a very different perspective from the breeders who view GM technology or the role of the laboratory as a tool that aids in making the breeding process faster, and most importantly, consider it as a part of the process rather than rather than the process itself. As Prabhakar Rao, Chairman, NSL Group of Companies Pvt. Ltd., and a practicing breeder, pointed out, "Biotechnology cannot replace conventional breeding. *Bt* is slightly different, not significantly different. The key is integration of the technology into your hybrid. Inserting the gene into the plant is easy. But the difficult part is making the hybrids. That is where the role of the breeder comes in. You have to keep in mind the yield, pest resistance, quality of the fiber, all these parameters you have to improve. These are ongoing continuous process."

There was a clear disjunction between the breeders and the biotechnologists as far the meaning of GM seeds or agriculture biotechnology was concerned and some of the breeders had not even visited any of the labs or did not know the kind of work that the biotechnologists undertake at the lab. As a junior breeder, Kamal, pointed out to me, "the main work of coming up with the best hybrid happens in the field. The lab is just there to support us when we need to know whether a plant carries the *Bt* gene or not. Beyond testing, the lab has no role to play in actually creating the hybrid." The importance given to breeding by the company is also reflected in the difference in salaries received by the breeders and people working in the laboratories. The starting salary of a junior breeder is around INR 45000 per month whereas the salary of someone working in the biotech lab can be anything between INR 10,000- 30,000. The idea that technology itself holds the promise of better yields and therefore, better life of farmers but it is the use that it is put into determines the ultimate value, is a rhetoric that I came across while speaking with several scientists whether in the seed companies or the government aided research institutes. The paradox of science interlaced with uncertainties and science as the seat of objectivity, was transposed on to the breeding plots and the labs--- the two main spaces of manufacturing *Bt* seeds. The process of breeding and escalating the chosen populations to the next level finally reaching a marketable hybrid, is entwined with trial and error, prediction, experience of the breeder, knowledge of the parent varieties moving back to a few generations. This significance of chance and anticipation that get manifested in the field is counterpoised by the rigor of testing and constructing certainty in the space of the laboratories. And, the finished commodity, the seed, erasing the unfinishedness and contingencies of the process of its coming into being, becomes the embodiment of certainty, reassurance, and promise.

The Field, Breeding Seeds, and Their Unfolding in Time

"What is a good seed?" I asked Mahantesh Satihal, the principal cotton breeder at Nuziveedu Seeds Limited. He promptly replied, "the good seed, or the best hybrid, is the one that emerges into a pant that looks good, yields more, and is resistant to most pests. The idea of the ideal cotton seed differs from region to region but at a very basic level, this is what a good seed, or the best seed aims for." The cotton breeders were the busiest people in the company with frequent travels scheduled around the country to evaluate the performance of different hybrids, supervising the junior breeders, and visiting the multi-location trial (MLT) plots across different parts of the state. The entire breeding team (of cotton and all other crops) was an all-male community. That, along with their need to maintain boundaries about sharing breeding information with me, proved to be quite difficult to surpass from the beginning of my fieldwork. I proposed to accompany the breeders on their trips to plots in the nearby regions within the state but they expressed their discomfort with the proposal. Groups of three or four men travel in a car and often share a hotel room in these station trials. I was told quite explicitly that my presence as a woman would be uncomfortable for the entire team. I wasn't left with many options but to visit the fields that did not involve any overnight stay. The plots are usually sequestered from the central areas of the village or the town where they are located. Only the breeders know how to reach them, crossing circuitous, unpaved alleys on motorcycles. I could access three plots during my fieldwork--- Bandamailaram, Kalakal, and the small research plot located on the campus of NSL. In a place like Telangana where work, mobility, and everyday interactions are often marked and separated by gender, hitchhiking with men on motorcycles was quite an unusual sight for everyone. My position of being a familiar stranger--- conducting research in the company but not being a part of it, studying in an international university, belonging to the country but not the state where NSL is based--- made the experience possible.

My first day at the Bandamailaram farm, a 14 acres research farm which is around 30kms from the main campus, was an enthralling experience. My first impression was that the farm had several cotton plants that were neatly planted in rows in specific plots that were separated on some basis that I was not familiar during the first few visits. Once the junior breeder, Srinivas, began to explain all the programs, I slowly started noticing the differences between the rows, columns, and plots. During the first week on a sweltering Wednesday morning when I was trying to get the lay of the land, he explained, "the main aim of every breeder is to come up with a hybrid that outshines all others in the market. It is difficult. It takes time, up to six to seven years for the hybrids to stabilize. We have certain breeding objectives that we receive from the senior breeders and there is always the "check" or the "model plant" of any brand that is working best in the market in a particular season, and we make our selections accordingly."

Monsanto sold its *Bt* technology in Cocker 312 cotton seeds to the Indian companies, its sublicensees, in lieu of a lump sum (INR 50 lakh for NSL) and a continuous payment of trait value every year against the sale of each packet of seeds. Cocker 312, carrying the *Bt* gene is the donor parent (male) and the recurrent parent (female) is selected by the breeders based on the research objectives. From the donor parent, the main aim is to carry forward the *Bt* gene to the next generations whereas the recurrent parent embodies the desirable characteristics that the breeder envisions the final hybrid to possess. The method that they primarily follow is back crossing where after crossing the Cocker 312 plant with their chosen variety, the first filial generation (or F1) plants are again crossed with the recurrent parent and this process is continued until the traits stabilize in the sixth or seventh generation. Since the flower is hermaphrodite, crossing mainly involves emasculating a bud by removing its male part and rubbing pollens on the female part the next day. The emasculation process usually takes place in the evening (by around 4PM) when the sun is not scorching. Srinivas showed me the process. They first identify buds that are about to open the next day. It's the assessment of the size of the buds that helps them perform the emasculation process at the right time. By applying slight pressure with both the thumbs, a rupture is created on the outer covering of the bud (the staminal column), which is the male part. It is then removed, leaving the stigmatic surface (the female part that looks like a thin stalk with a round head on top). The next day, from 10AM-noon, pollens from the desired male plants are rubbed on the female surface. It takes two seasons to get two generations and the entire process of reaching F7 takes 6-7 years. In the 6th or the 7th year, the promising hybrids moves towards commercial release.

"Selection" is key to breeding--- to identify the plants whose traits seem desirable and that combine well with the other parent. That is where the role of technique and knowledge of the germplasm come in. With a single breeding objective like bigger boll size in mind, different breeders inevitably select different parental lines depending on their experience of working with various varieties over time and their intuition of what might actually work."
Mahantesh Satihal, the principal cotton breeder at NSL.

The extravagant goal of coming up with the next tour de force is accompanied by the minutiae of making a few thousand crosses every year and following them closely day and night, year after year, until the sixth or seventh generation. Starting with around 1000 crosses with 20-30 males and 20-30 females, the breeders attempt several permutations and combinations to see all the possible traits. Through the Line Development Program, the best plants are hand-picked from a collection and planted in a row. They are then tested for the presence of *Bt* genes. If all the plants in a lot look alike for two consecutive years, the line is considered stable. They are sometimes tested for homozygosity test which ensures the breeders that the offspring possesses two identical genes, each one inherited from each parent. That line is taken for further crossing. Out of these 1000 F1s, around 250-300 promising ones are taken to the next level. The first few crosses between *Bt* cotton plants and the indigenous varieties are performed at station trials (STs) that are smaller experimental plots within the campus of the company. The plants are studied on the basis of yield, fiber quality, boll size and numbers, and the external appearance. If not necessarily reflecting conceptions and judgements about vexed topics like race, descent, and pedigree in breeding Chillingham cattle that Harriet Ritvo writes in "Race, Breed, and Myths of Origin: Chillingham Cattle as Ancient Britons", there were notions of "goodness" that differ from one region to another and it is the responsibility of the breeder to pay attention to that.

The selected F1s are again reproduced. After the station trials, the selected 4-5 varieties are proceeded to multi location trials that the company has in Pargi and Guntur in Andhra Pradesh/ Telangana. Similarly, these multi location trials happen across north, south, and central zones to see the adaptability of the hybrids. If the hybrids perform as expected in all these regions, they are taken to the next level of commercial field trials called field demonstration, where one or two hybrids are planted in 1-1.5 acres of a farmers' fields and their performance gets demonstrated to the farming communities. The entire process takes around 7-8 years. Only the few senior breeders who have been working with the company for several years have the knowledge of the history and lineage of each plant in the research fields. For the junior breeders, the plants are numbers with different colored tags denoting the various generations or stages of the plants. The physical characteristics as well as the genetic make-up of the plants that are used in making the crosses are indeed the trade secrets that are fiercely protected by the company. Very few people in the company are aware the original recurrent parent of each of these hybrids. Someone like Prabhakar Rao who has been practicing breeding for over three decades can foretell the future of the hybrids by recollecting the life cycle of the parent plant. Time gets redoubled, sedimented in the seeds as they constantly race against time.

There are a few supporting programs stretched across the area of the research fields to carry forward this process of making crosses. The most important among them is maintaining the germplasm. I was astonished when I saw a plot with unusually tall cotton plants--- 10-12 feet instead of the usual 3-4 feet of the commercial kinds and leaves that looked nothing like the ones I had been seeing in most plants throughout my fieldwork. They were either larger or narrower at the edges unlike most of the commercial cotton plants. I also noticed that the size and shapes of the leaves were different at the top than the bottom of the plants. Next to these were cotton plants with light brown fiber instead of the usual white. I learned that those are the germplasm or the collection of all wild, as well as, indigenous varieties of cotton plants available to the breeders to experiment with. It's indeed this genetic diversity that gives any company or institution its edge over its competitors. As Srinivas pointed out, it is the "bank balance, the capital" that one can use to produce many hybrids for years. The company maintains a stable collection of non-*Bt* hybrids that can be made commercial in case the government decides to ban *Bt* cotton at any time. It is ironic that these varieties of cotton plants have become the property of private companies and a few research institutes whereas the market for cotton seed is flooded with *Bt* cotton. The lack of diversity of cotton varieties that had mildly set in in the cotton market since the cultivation of (non-GM) hybrids in the 1990s, has taken a different shape altogether since 2002. Rearticulating M-C-M (money-commodity-money) that Marx considers as the fundamental logic of capitalism, for the seed companies, the raw material itself is money, and the field is the factory. The germplasm, begets money in this case. During my visits in several rural areas since 2013, I rarely came across seeds that were not *Bt* cotton. Focusing only on cultivating cotton instead of planting alternate rows of other crops, and further, using only *Bt* cotton instead of other kinds of hybrids or varieties have been repeatedly critiqued by activist groups (Shiva 2005).

The idea of the seeds trailing from the lab to the field transformed quite significantly for me during the first few weeks at NSL. The field is the laboratory as far as most of research here is concerned because the breeding process is completely field bound, with the labs equipping the breeders with nuanced information on the seeds. The central aim of the company (and I would imagine for most companies) is to develop hybrids by inserting *Bt* genes in indigenous varieties that are both phenotypically (morphological characters like plant height, size of the leaves, size and number of bolls etc.) and genotypically (the characters of the gene: the presence of *Bt* gene to resist bollworms, the characteristic of high yield) attractive to the farmers. But once one enters the research field of the company, one realizes how complex the relations between several processes are and the relation between different scales of time that play out in the field. What I really found overarching during my visits to these fields and through many conversations that I had with junior and senior breeders, is this constant negotiation between the impending that is unknown and the temporality of the process of breeding. It is a matter of 'catching up' with the emerging environmental tangles and the unforeseeable agricultural policies adopted by the government. Along with the test plots for the Bt hybrids, there were a few acres of non Bt hybrids that were being cultivated in the field in case the government suddenly bans Bt. The phrase, "the hybrid that outshines all others in the market" sounded elusive to me because it is hard to find any objective like big boll size, higher number of bolls, higher yield, phenotypical characteristics of the plant that is not already covered in the number of hybrids in the market.

Laboratory, The Seeds, and Erasing Time

The everyday uncertainty that is characteristic in the field is tinkered with, worked upon, and tested in the laboratory to gradually disintegrate it and encase the seeds in layers of certainty and objectivity. It is in these labs that genetically modified seeds get constructed as scientific objects. The phrase "research seeds" that gets highlighted by the company representatives during "field days" (events organized by companies during the penultimate stages of the harvest, exhibiting their best crops for the season and explaining the virtues of the seeds) across different villages, has its roots in the processes in both the biotechnology and the Seed Testing Laboratory (STL). The biotechnology lab primarily tests the presence or absence of the *Bt* genes in seeds during various stages of the process of research and production. The STL, on the other hand, performs germinations, seed purity, and moisture tests that are mandatory for the seeds to be commercially sold. The Government of India has stipulated the minimum rates of germination, genetic purity, physical purity, and moisture content to be 75%, 95%, 98%, and 6% respectively for each packet of 450 Grams of cotton to possess the "Truthful Label". Unlike for hybrid seeds in vegetables or other crops, *Bt* cotton is not certified by the seed certification agencies that are established in different states of the country. Instead, the responsibility of delivering non-spurious seeds that meet the standards stipulated by the government, lie with the seed companies through what is termed as "Truthful Label". When the seeds by different companies are promoted to the farmers, these percentages and numbers are often reiterated to claim legitimacy for the seeds.

During most of my conversations with biotechnologists and research assistants in the labs, the importance of certainty and objectivity in delivering the best seeds to the farmers emerged in almost all the conversations. During one of our conversations regarding objectivity I asked Dr SP, how can one be certain about the performance of the seeds in the face of environmental challenges and what does conviction on the seeds, and in science, rest on? He pointed out the "scale" plays an important role in being objective in science. "When Hooke discovered the cell on a bottle cork, only a little bit could be seen. His experiment was done with a basic microscope. When that same cell is magnified at 10x and 100x, you get to see closer and new attributes and characteristics come to light that were always there. We would use isozomes fifteen years back. That was replaced by RFLP, and then the Single Neucleotoid Polymerasim.

Now we use Polymeraise Chain Reaction (PCR). So the gene has always been there. We are seeing it at a different scale and that makes a tremendous difference." I suggest that this granularity and objectivity of *method* that the biotechnologists, research scientists, and everyone else working in the lab see as the primary value of the lab and their work, becomes the scaffold that constructs the seeds themselves as objects of certainty, objectivity, and calculated hope. The imagination of the seeds as significant objects, that hold magnificent promise, breed flagrant mistrust, or that get sewn up in the tapestry of the everyday in agriculture, is born in the spaces of these labs.

The biotechnology lab is the liveliest among all the labs, with regular arrival of leaf samples from the breeders at unanticipated hours of the day, leading to a deluge of activities in the lab. In my second week there, Ankita Bose, an intern with the company, gave me the splendid news that a few packets of cotton leaf samples from different lots had arrived in the lab to confirm the presence of *Bt* genes in them. The team was more than happy to use another pair of hands in the rather tedious chain of tasks. The first step is to forcefully grind the leaves in 1.5mL tubes with cetyle trymethile ammonium utirate (C-tab) buffer solution with a plastic pestle for around a minute until the sample disintegrates and mixes well with the buffer. The breaking of the cell walls through this process is called lyses, which helps all the inner materials like the protein and the DNA to get released and get mixed with buffer. The buffer aids the process of the cell wall to break and release the cell components. The tube is then incubated in water bath at 65 degrees for 30 minutes. After mixing gently, it is centurifuged at 13200RPM for 10 minutes. The centrifuge machine carries several tubes at a time and rotates around a fixed axis with an outward force (or force that is perpendicular to the axis) that leads to the sedimentation of the denser particles at the bottom, and the lighter material in the tube (including the aqueous layer containing the DNA) at the top. Once taken out from the centrifuge machine, there are three distinct layers (the aqueous layer, protein, and chloroform). The clear supernatant is collected and ice cool isopropanol is added that leads to the precipitation of DNA.

The main purpose of this process is to isolate the DNA and then make thousands of photocopies and amplify them through the process of polymerase chain reaction. The copies are then used to carry on any kind of analysis of the DNA. There are pre-developed markers, or locations of DNA sequences on a chromosome that can be used to identify the presence or absence of certain traits in the gene. Once these markers, or primers, are mixed with the DNA of a sample, the specific location binds with the primer and gets amplified. One can read if the plant has *Bt* gene or not, or which part of the gene is responsible for certain characteristics. Markers like RAPD, ISSR, SSR, SNP, CAPS, AFLP, are preferred by the company. In a short period of time, the marker assisted selection method can provide the breeders with results on whether a certain lot of seeds carries the Bt gene. Instead of relying on phenotypic characteristics to determine the presence of Bt genes, this speeds up the process of continuing with the different stages of breeding.

The Seed Testing Laboratory (STL)

The Seed Testing Laboratory (STL) is located in Komaplly, which is around ten kilometers away from the main NSL campus at Medchal Mandal. The presence of a market area selling commodities of daily use around the campus where the STL is located, marked this place as distinct from the path of dried trees and factories that led to the campus of the main NSL office at Medhchal. Several employees who work at the Medhchal campus live in Kompally. The STL is housed in a building that primarily has administrative offices on the rest of the floors.

One distinctive feature of this lab is the large number of women employed to carry out the various tests on the seeds. Other than two men compiling the data on computers, the works in this lab is carried out by women. After spending weeks with the breeders and consciously adopting and adjusting to the gender position that seemed acceptable, my time at this lab was a welcoming change. This was a smaller space with one large room that had several large desks where everyone worked. "We test the seeds primarily for germination but also for physical purity, moisture, and vigor. We always try to strictly follow the rules for seed testing formulated by the International Seed Testing Association. At the end of the day, performance is what matters. If the seed doesn't germinate, there is no point of anything. We try to make sure we deliver the best seeds to the farmers", explained Rajani Mondepu, Deputy General Manager, Quality Control at NSL. The practice of seed testing rests on the premise of uniformity, that is, "any seed testing carried out on the same material should ideally give the same result" (ISTA Vision: Uniformity in Seed testing) because uniformity in testing methods is considered a sign of quality and allows different partners to engage in transactions around seeds.

Different kinds of seeds reach the STL but they are mostly at advanced stages in the process of being commercially available in the market. The STL receives seeds from breeders who have been working on developing a certain hybrid for a few years, farmers who have entered into contracts with the company to cultivate hybrids produced by the company in their fields, and even hybrids made by smaller companies that do not have their own STLs. Once a lot reaches the STL, it gets divided into three or four parts to test them for moisture, purity, and germination. To test the moisture content, that is, the content of water in seeds, two main methods are used--- hot air oven method and meter method. The level of moisture determines the quality and shelf life of the seed. The hot air oven method weighs the seeds before and after drying in a pre-heated oven and the difference in weight is recorded as the moisture content. In this method, high constant and low constant temperatures are used depending on the seed type. For most seeds other than oilseeds, the high constant temperature of 130-133 degrees Celsius is used and the seeds are dried for around 1-4 hours. At NSL, they use the moisture meter that is faster but sometimes, slightly less reliable because they need to be calibrated and that often opens up scope for inaccuracy. The meter method is based on the measurement of dielectric properties or electrical characteristics of the seed that is directly related to the moisture content of the seed. Instead of directly measuring the moisture content of the seed by weighing it before and after drying as the hot air oven does, the electric meter is based on the principle that there is a directly proportional relation between the dielectric property of the seeds and the content of moisture.

Water is a good insulator which means that it has tightly bound electrons that can store electric charges, the measure of the amount of which is known as the capacitance. "A dielectric constant can be determined by measuring the capacitance of a capacitor (two conductors or plates), with air between the plates, then measuring the capacitance with the dielectric material between the plates. The ratio of these two measurements is used to determine the dielectric constant. The dielectric capacitance technology used in many grain moisture meters is based on the principle that a functional relationship exists between the moisture content of the grain and its dielectric constant. As grain increases in moisture content (water), its dielectric constant increases. The rate at which the dielectric constant increases is not the same for all grain types, therefore a unique calibration equation must be developed for each grain type to be measured. Moisture meter based on dielectric principle typically incorporate a test cell in the form of an electric capacitor, that is, two conductors separated by an insulator. When the cell is empty, only air separates the two conductors, and the insulator is air. When a grain sample to be measured is placed between the conducting surfaces of the test cell, the grain displaces most of the air. By sensing the change in the electrical characteristics of the capacitor due to the dielectric properties of the grain sample the meter can predict the moisture content of the sample."

After the moisture tests, the seeds are tested for physical purity where a working sample of 350 Grams is selected from a lot of 1Kilogram seeds. Based on visual analysis, physical purity is determined by the approximate number of inert matter, pure seed, and other weed seeds. Inert matter is identified if the seeds have a visible fungal coating or the color is dull compared to most other seeds in the lot. Weed seeds are seeds that do not resemble the majority in the sample or that do not confirm to the description provided by the person/group submitting the lot for these tests. If a lot has high percentage of inert seeds, it is rejected for further tests or towards commercial availability. From the remainder, the pure seeds, around four hundred seeds are taken to the next, and the most important level, the germination test.

Without the presence of any tool or machine, the germination test is the most labor intensive. I spent most of my time in this lab helping the lab workers with germination tests. Groups of around 5-6 women sit around each large desk and nimbly place around thirty seeds on one half of a presoaked, brown color blotter paper. They then fold the other half on to the side where they place the seeds and tie it with a rubber band. The folded papers are then wrapped in polythene wraps to hold the moisture. The water usually holds for four days. They are stored in temperatures of 20 degrees or 30 degrees Celsius, where it takes 16 hours and 8 hours respectively to germinate. Once the period is over, the papers are opened, and the seeds that germinate well are counted. The shoot length and the root lengths are observed to note the speed of germination or what is known as vigor of the seeds. The appearance of the seed is also noticed. Sometimes if the first round of observation does not seem satisfactory, water is sprayed again, and the entire process is repeated to check the rate of germination of the seeds. The lots are graded A,B, or C based on the vigor percentage of each sample. With an evaluation of around 200 samples per day, NSL performs tests on 2.5 to 3 lakh samples per year.

During conversations with the team working in the lab, there were several occasions where the quality of the seeds was related with the ability of the lab to follow the rules of each test. The more accurate the method to conduct these various tests, the higher the chances of detecting good seeds and follow them to the next levels of cleaning, packaging, and marketing. "Unless the method of testing is accurate, it is difficult to know how the seeds will perform. There are external conditions that we sometimes cannot control. But given similar conditions, the performance should be standard if the seeds are good", explained Anita, one of the team members.

If goodness was explicitly measured based on germination rate, moisture content, and physical purity of the samples, there was always an underlying current that was inextricably linked with the measurement of goodness. That was the alertness of pace---the biotechnology laboratory as well as the STL embodied the idea that being fast is being good, not only as a core of capitalist theory where time is of the essence, but also as one of the fundamental values of agricultural biotechnology. Understanding biotechnology as a *method* in the larger practice of breeding, the breeders explained the relation slightly differently: biotechnology is a tool to make breeding faster but it can never replace conventional breeding. The breeding community certainly considered themselves as the most important agents of innovation and strongest actors in bringing in profit for the company. This was reflected in the relation that they had with the lab. Although most people working in the lab were familiar with the names of breeders, the breeders, especially the junior ones, had not visited the lab even once during their period at the company. They would often point out that they do most of the work and the lab is there to give some quick, objective inputs to accelerate their work.

If breeding added value to the seed by slowly unfolding goodness at each generation of the seed over a period of a few years, the lab added value by compressing time and adding certainty at several points of the process of breeding. In *Species of Biocapital*, Stefan Helmreich describes biocapital by providing us with an analogous formula to Marx's M-C-M". In *Capital*, Marx shows us how money becomes capital by passing through the commodity form that is endowed with exchange value. Helmreich describes the "making of biology into capital" (Helmreich 2008: 472) through the formula B-C-B", where "B stands for biomaterial, C for its fashioning into a commodity through laboratory and legal instruments, and B" for the biocapital produced at the end of the process, with "the value added through the instrumentalization of the initial biomaterial" (Helmreich 2008: 472). This biocapitalist link gets complicated in the case of agricultural biotechnology as opposed to biotechnology in medicine because the inextricable link between capitalism and biotechnology that is primarily enacted and represented in the labs, is only a part, often an insignificant part, of the entire life process of the production of the seeds as commodities. Further, the *bio* of biocapital, in this case, is simultaneously the *Bt* technology as well as the germplasm of the Indian seed companies but Monsanto has rights over the former whereas the latter is owned by the Indian companies. The question *who* owns this bio material and what are the legal, political, ethical, and economic landscapes that the materials emerge from make the formulation of biocapital multi layered. And, finally, the discontinuous, contingent experiences of time of breeding, coupled with the temporality of the seed's unfolding, make it difficult to neatly lay out and calculate the necessary and surplus labor time that Marx considered as the fundamental basis on which capitalism is built. The experiences of the breeding community around making, producing the seeds and the seeds, simultaneously, becoming, unfolding through practices of the breeders, is characterized by prolonged, contingent, striated experiences of time. The contrasting experiences and articulations of time by the breeders and the biotechnologists were overarching during my stay at the company. The way in which each community situated themselves and measured their work in terms of time was inextricably linked with their relations with the seed and their conceptions of what a good seed is. During conversations over lunch or interviews in the lab, I would encounter the phrase that biotechnology is like traveling by airplane instead of a bullock cart. One reaches the destination faster but at the same time, like airfare, the costs are higher. The lab perceived their own value in making the breeding process faster and more certain/ objective. The objectivity and assurance that are attached with following the rules to measure the goodness of the seeds or the presence/absence of Bt genes is often considered valuable because it accelerates the larger, and more significant process of breeding and producing the ideal seed every year. The breeders' time and times' labor are habitually erased in the space of the lab. Speed is valorized. And, the objectivity of method in the form of following the rules, inscribes the seeds with their thing-ness, object-ness, and in a away, endows them with exchange value.

From What is Good to What is Right: Creating Ethical Plateaus

Early on during fieldwork I encountered a simmering tension among breeders, lab workers, and even the cleaning and maintenance staff in the company. There were murmurs, anticipation, and speculation about the "case". Nobody was willing to explicitly talk about it but I learned that the future and nature of employments within the company depended on how the "case" would unfold. Unlike several corporate firms in the country, NSL is known for being paternalistic about hiring spouses of people already working with the company or not dismissing people even if their work doesn't meet the standards of the company. But while I was doing fieldwork, I heard floating murmurs about the ways in which the company was trying to bring down costs at every level--- from using fewer paper towels in the labs to putting a cap on hiring new people. The reason, as I later found out, was a legal battle that had ensued between NSL and Monsanto and if the High Court's decision would favor the latter, then NSL would need to pay a large sum of money to Monsanto. Since 2002, Monsanto's associate in India, MMB has licensed around forty-six companies (or sublicensees), enabling them to sell hybrid seeds that has Monsanto's patented bollworm resistant, genetically modified technology. In February, 2016, the plaintiffs --- Monsanto Technology LLC (1st plaintiff), Monsanto Holdings Pvt. Ltd. (2nd plaintiff), and Mahyco Monsanto Biotech (3rd plaintiff) impleaded three defendants—Nuziveedu Seeds Ltd., Prabhat Agri Biotech Ltd., and Pravardhan Seeds Pvt. Ltd., (1st, 2nd, and 3rd defendants) on the grounds that the defendants had continued to "market and sell Genetically Modified Hybrid Cotton Planting Seeds in spite of termination of the sub-license agreements, including trademark sublicense agreements, alleging violation of their intellectual property rights vis-à-vis the registered patent (IA 214436)… and trademarks Bollgard and Bollgard II" (BT Cotton Delhi High Court Stay: 2). Monsanto had just terminated the agreement signed between the parties in 2015 because of the failure of the sublicensees to pay the amount of trait value that the two parties had mutually agreed upon. After the agreement was signed, some of the state governments proposed a reduction of trait value to Monsanto and the sublicensees started paying the reduced value instead of the one that was stated in the agreement. Monsanto found this unacceptable and terminated the agreement. Until then, every company paid around INR 169.29 as royalty for each packet of 450 grams of *Bt* cotton seeds sold in the market. Each packet of *Bt* seed was sold for INR 930 in the states of Maharashtra, Andhra Pradesh, and Telangana until the Kharif season of 2014. In 2015, the Maharashtra government reduced the price of each packet by INR 100. The states of Telangana and Andhra

Pradesh retained the price but reduced the trait fee to INR 50. Monsanto sued the companies because the trait values had already been determined through agreements between the Indian companies and Monsanto and therefore, the companies were expected to abide by that amount instead of the lower amounts proposed by the state governments.

The seed companies contended that the International Seed Federation (ISF) has upheld Fair, Reasonable and Non-Discriminatory (FRAND) licensing based on the International Treaty of Plant Genetic Resources in Food and Agriculture, to which India is a signatory. When the Indian government allowed MMB to sell *Bt* seeds in the market, there was an absence of a stable mechanism to control and regulate the prices. The price of *Bt* packets of 450 Grams in the first year was INR 1800 that carried a trait fee of INR 1250. It took around four-five years for the state governments to lower the prices by a few hundred rupees per packet. The Indian companies highlighted the provision in the Treaty that promotes fairness in transfer of technology. Under the section, "Multilateral System of Access and Benefit Sharing", the Treaty states: " …access of transfer of technology… including that protected by intellectual rights to developing countries that are Contracting Parties, in particular least developed countries, and countries with economies in transition, shall be provided and/or facilitated, under fair and most favorable terms in particular in the case of technologies for use in conservation as well as use of technologies for the benefit of farmers in developing countries, especially in least developed countries and countries with economies in transition, including on concessional and preferential terms where mutually agreed, inter alia, through partnerships in research and development under the Multilateral system. Such access and transfer shall be provided on terms which recognize and are consistent with the adequate and effective protection of intellectual property rights." (International Treaty of Plant Genetic Resources in Food and Agriculture: 21). But Monsanto insisted that the nucleotide sequence (or the *Bt* technology) is their patented invention and its use by the defendants after the termination of sub-license agreements is an infringement of the monopoly granted by the patent and the substantive rights under Section 48 of the Patents Act. The presence or absence of other materials, they further contended, is immaterial as long as the patented nucleotide sequence was present in the seeds that the defendants continued to sell even after the termination of the agreement. Monsanto further argued that the nucleic acid sequence is a "chemical composition" and not a "micro-organism" or a "living thing". The main difference between the two being that the former cannot reproduce itself whereas the latter can. "When the "nucleic acid sequence" is incorporated into a living organism, it imparts the Bt. Trait (insect resistance) to the living organism…it was argued by the defendants that in view of section 3(j) of the Patents Act, there can be no patent rights granted in respect of plants or seeds that contain DNA sequences.." (BT Cotton Delhi High Court Stay, 67).

The defendants argued that according to the Indian Patent Law, the moment the sequence is introduced into any part of the plant cell, it becomes non-patentable. They further evoked the Plant Varieties Act and the National Seed Policy to substantiate their argument. Recognizing the rights of the researchers, Section 26 of the Plant Varieties Act states that if a researcher (example plant breeder) creates a new variety using parts of another variety with certain traits (*Bt* trait in this case), the breeder can claim "benefit sharing". So the defendants opined that the only claim that the plaintiffs may press against them would be that of "benefit sharing" as the biological process that they are engaged in does not create another nucleic acid sequence, nor do they practice any method that inserts the nucleic acid sequence into a plant cell. As far as the accusation of the use of the registered trademark Bollgard and Bollgard II was concerned, the defendants argued that there was no proof that "BG"and "BGII" were the abbreviations of Bollgard and Bollgard II--- "… by virtue of Section 30 of Trademarks Act and the use of the expression "BG" by defendants is *bonafide*, it being descriptive of the character and quality of their seeds as is widely used in the seeds industry, mark "BG-II" being in fact registered as a trademark by a third party (Maharashtra Hybrid Seed Company Ltd)." (BT Cotton Delhi High Court Stay: 70) The court order was in favor of Monsanto. NSL was expected to clear all dues that had accumulated because of the differential payment of the trait value. NSL appealed to the High Court once again.

The second time, NSL contended that "plants" are excluded from patentability under Article 27 (3)(b) of the TRIPS Agreement to which India is a signatory. Ms. Pratibha Singh, the senior counsel for Monsanto, argued that as much as any plant or plant parts are ineligible to be patented in India as well as the ordinary biological process in creating them, micro-organisms are outside of that purview. She argued, "...the subject patent does not cover the plant... but covers microbiological processes. Such processes include <u>methods of creating transgenic varieties</u> and *microorganisms* which are new and inventive transgenes and their constructs. These are patentable under *Patents Act*. Monsanto's patents cover these constituents. Bt cotton technology is not constant but has been refined to address the needs of pest resistance." (High Court Order, 22). Hitting back at NSL's argument that plants and living beings cannot be patented, she further argued that no part of the DNA sequence is a living organism. Neither is it a plant or a plant part. It cannot be referred to as a plant part because, "it is not like an organ of an animal or the physical attribute of a plant like flower, fruit, etc." (23)

The fulcrum of the debate lay in interpreting the meaning of the phrase "essentially biological process". The primary challenge that emerged before the court was to determine what *degree* and *kind* of human or technical intervention around a plant allows for it to be outside of "essential biological process" and therefore, brings it within the scope of patentability. To expand on the definition of "essential biological process", the court cited rulings including *Plant Bioscience Limited vs. Syngenta Participants AG GroupeLimagrain Holding* (G2/07), *State of Israel-Ministry of Agriculture v Unilever N.V.* (G0001/08), and *Plant genetic systems v Greenpeace* (T0356/93). Citing the European Patent Convention of 1973, the court emphasized that to term a process as "essentially biological" depends on "the essence of the invention taking into account the totality of human intervention and its impact of the result achieved" (Article 53 (b), EPC, 1973). The court, in the end, pronounced in favor of NSL on the bases that a) transgenic plants with integrated *Bt* traits are produced through hybridization which qualifies as "essential biological process", and b) the *Bt* trait, in the end, is a part of the seed. By itself, it has no intrinsic worth. Elaborating on the first point, the court stated, other than several other products, "the process of integration and further hybridization sets into motion a chain of events, which is part of nature…" (48). The first fifty donor seeds that Monsanto had sold to NSL were eligible for being patented because those, in a way, embodied the technology. But the seeds that NSL has been subsequently creating by following several breeding techniques cannot be patented even though each one of those seeds contains the *Bt* technology.

The High Court ruling in favor of NSL is significant for multiple reasons. To begin with, directing a ruling that is against the giant multinational Monsanto and its sinewy, reticulus lobby is itself path breaking, especially in the face of the consistent formulation of policies favoring investments from international corporations since the early 1990s. It indeed forges a new epistemology, a way of understanding the relation between biotechnology on the one hand and the role of the market, breeding communities, and the state on the other. In *Biocapital,* kaushik Sunder Rajan describes specific configurations of the abstract and the material as one of the basis of biocapital. And that configuration is the way in which "genomics fundamentally enables a particular type of materialization of information, and its decoupling from its material biological source (such as tissue or cell line)" (Sunder Rajan 2006: 17). As I have mentioned in the chapter earlier, the logic of biocapital as one encounters in medical biotechnology gets complicated in agricultural biotechnology. Whereas Monsanto argued for an abstracted of the nucleic sequence as "non-living", the court order, repeatedly, through several references of other cases and multiple explanations, rooted its decision in the very material, commonplace thing, the seed itself. Yet, the use of the concept, the meaning, and the materiality of the genetically modified seed constantly shifts between being spectacular and every day, an exemplar as well as the general, novel and quotidian at the same time. After the saleof the donor seeds, the court argued that the subsequent generations of Bt seeds that were produced by NSL contained the Bt technology but they were *incorporated* within the seed which is a part of a plant. In their pronouncements, the seeds are simultaneously part of nature even when they emerge out of years of human intervention in the form of breeding, as well as, exemplary because of the presence of Bt gene in all the subsequent generations of seeds. The arguments are thus centered on the materiality of the seed, yet there are constant references of them being part of biological *process* that involves time as well as critical role of the breeders.

Second, the High Court judgement is significant and unprecedented not necessarily because of its decision but the logic used by the court to justify its decision in favor of NSL. The use of the phrase, "essentially biological process" ultimately condenses into the *degree* of human and technical intervention in the process of "production of plants which is based on the sexual crossing of whole genomes and the subsequent selection of plants" (42). If the kind or degree of intervention only enables or assists the performance of process steps, it is not eligible to be patented. In determining that, the High Court evokes interesting concepts of "nature" and "life". There is a plethora of anthropological works in the past three decades that contemplates on thinking about "nature". The meaning of nature has become particularly significant in thinking about biotechnology in terms of both limits and thresholds of human intervention when for instance, a gene is spliced or a gene of a soil bacterium is inserted in a plant seed. Explaining how "ideas contain other ideas", Marilyn Strathern used "merographic connections" to study the relation between the biological and the social in thinking about what relatedness means in kinship (Strathern 1992). Rather than formulating the link between biological/social and kinship as parts and the whole, she showed the "ways in which 'parts' *overlap* in the production of ideas about relatedness" (Franklin 2003: 66). The natural/biological domain, for her, belongs to the biological, which itself is a whole, just like, the social, which is "after nature" is itself a whole. She explains this by giving examples of the names that one uses to address relations of kinship like father, mother on the one hand, and the names that are used to denote genetic markers on the other. "Both kinship and new genetics connect these distinct domains 'merographically' because in the idea of a kinship relation, or a genetic marker, is the idea of co-mingling of parts that belong to different 'wholes'" (Franklin 2003: 67). Paul Rabinow and Donna Haraway configures the relation between nature, culture, and technology in slightly different ways. For Rabinow, the social cannot be thought of as "after nature" but is "new nature" which is "remade through technique" (Rabinow 1996: 99). He terms this "biosociality". Hans-Jorg Rheinberger elucidates Rabinow's point of "modelling": "The momentum of gene technology is based on the prospect of an inter-cellular representation of extracellular project—the potential of 'rewriting' life" (Rheinberger 2000: 19). His emphasis on the *kind* of intervention and the *scale* of biological control and "the ability to 'instruct' metabolic processes using 'informational molecules' to redirect bodily processes" (Franklin: 2003), is important to remember in reading the High Court ruling. Although the terms DNA or genes do not appear anywhere on the Indian patent Act, the main distinction that is drawn in granting patents in medical biotechnology is based on the whether a process or an intervention is an invention or a discovery (Chowdhury et al 2014). The contours of the two categories are blurred and open to interpretation. For instance, in 2013, in the case Novartis AG v. Union of India and others, Novartis challenged the decision of refusing to grant patent for its anti-cancer drug Glivec that had a betacrystalline form of imatinib. The court ruled that this form of imatinib was already possessed by imatinib in its free base form or its salt, thereby questioning the contribution of Glivec as different from the already existing medicines (Chowdhury et al 2014). In the case between NSL and Monsanto, the line between invention and discovery was translated in the question of what "kind" of intervention was made in producing the seeds and its "impact on the result achieved" (43). The novelty, if any, lay with the breeders' techniques of crossing the *Bt* seeds with their own varieties rather than the technology itself. Both practice and technology are inscribed in biology. And, nature, in this case, is "both our other and our "essential" self" (Fischer 2009: 156). Michael Fischer, in *Anthropological Futures*, writes about four kinds of "nature" to make sense of the emergent, urgent, everyday, and catastrophic events in the present moment. The first is, the "control of nature" in the face of catastrophes like hurricanes, droughts, and other calamities that create "deep play, sites where dynamically an increasing number of meaning structures implode or intersect and where society dramatizes to itself the meaning of its own representations about the moral order" (Fischer 2009: 119). His second nature, drawing from Friedrich Hegel, "is a technological and cultural nature that is increasingly difficult to separate from nostalgias from a lost, primal, and mythic first nature" (Fischer 2009: 124). The third nature is building nature "inside out" from the cell, tissue, molecule up to organisms, for instance. If the third nature deals with the genetic, biological, or biochemical, or trans species, Fischer's fourth nature is across species: between companion species, for example.

In analyzing, debating, and discussing the "essentially biologically process", the ruling then collapses first and third nature and the discourse shifts from what is *good* to what is *right*. NSL supports its argument by citing the Patents Act, 1970, which excludes from patentability "the mere discovery of a scientific principle or the formulation of an abstract theory or discovery of any living thing or non-living substance occurring in nature" (13). NSL urged that "plant breeding and introduction of traits in a variety is a natural biological process" as opposed to genetic engineering or methods in biotechnology to insert nucleic acid sequence in a plant cell which takes place only in the laboratory. Natural and biological are interchangeably used, not to separate itself from culture or practice. In fact, practice of the breeders (and farmers) is an inextricable part of the natural process of crossing two plants in this case. The "artificial" breeding process is still a part of nature or the biological in this case. If natural or biological is measured in opposition to something, it is the intervention of inserting the nucleic acid sequence, and specifically, the laboratory. Although this technological object, the genetically modified seed, is being crossed with other pure varieties and the final hybrids contain the inserted gene, it becomes natural or not natural depending on the *process* of production rather than what gets produced. Here, first and third nature are collapsed in the seed, with an added analytic category of *time*. As I understand, what is natural or biological, is not only how the breeders make sexual crossing between the genomes of two plants, but there is an implicit reference to time in the sense of practices and occurrences that have *always* existed. Instead of evoking a mythic time to justify what is natural, NSL recurrently circumscribed the processual, prolonged, and unceasing characteristics of time during which plants have been crossed by breeders and farmers. Continuity over time is what gives nature its affirmation. And, the breeder's time and labor is what gives the seed its value. The court pointed out that the termination of the agreement by Monsanto "without considering Nuziveedu's request was unwarranted" by stating: "128. The state government legislations or notifications issued on the subject in exercise of powers conferred upon them by such law, as indeed the Cotton Seeds Price (Control) Order, 2015, promulgated by the Central Government… provide not only the "law" but also reflect the "public policy" of the State and thus the "consideration" of the agreement between the parties, in order to be lawful within the meaning of the Contract Act must be in accord with such law and public policy and not be opposed or in derogation of" (54). The court considered Monsanto's decision of terminating the agreement as "illegal" and "arbitrary" indeed shifts the discourse around GM seeds from whether they are good to what is right. This court order also shifts the relation of the state with the Indian seed companies as well as the larger farming and activist communities. The agricultural department has consistently been in support of GM technology in the past decade. This decision places the state in a position of a double bind that further complicates the hitherto existing co constitution of efforts to modernize agriculture, its bittersweet relation with science, and the neoliberal economic policies. These emerging, transforming relations are further discussed in the next chapter.

Chapter 4

Biotechnology in History: *Techne*, Science, and the Nation

India has had a complex relation with science and technology throughout the 20th century, mostly because science and scientific practices have been seen both as means that could bring India at par with, as well as, mark itself distinctly from the west, especially England. Although movements of ideas from the colonial to the post-colonial periods and beyond are often more dialogic and surpass chronology, conceptions and significance of science got explicitly linked with the moment of independence of India from the British rule on 15th August 1947. This was largely because of Jawaharlal Nehru, the first prime minister of independent India, who imagined science--- both as an epistemology, practice, and a way of being in the world--- as the building block of modern India. David Arnold succinctly writes about the distinctive characteristics of Nehruvian science that got incorporated in several debates around science and technology throughout the decades after independence. Arnold points out that science, for Nehru, was a "philosophical and literary pursuit" that "created a space for postcolonial ownership and subjectivity, establishing the centrality of science in the autobiography of the Indian nation" (Arnold 2013: 361). Further, he writes, Nehru envisioned the authority of science as a form of knowledge produced in India that would challenge the monopoly of science by the west and would contribute to the world civilization. And, finally, Nehru understood science, functionally, in terms of India's national interest and her position in cold war politics. Replacing unquestioning belief that often formed the basis of religion, India needed to adopt the "scientific temper" (Nehru 1946: 512) that would be based on questioning the existing reality, testing, and using logical analysis in everyday life. At the same time, Indian science had to be humanistic and aim towards ameliorating the larger human conditions of poverty, disease, malnutrition, instead of being an end in itself.

Several scientists and scientific organizations that were established during the decades before independence were already exploring ways to juxtapose and intertwine what seemed as essentially Indian, whether it was tradition, philosophy, or more existential issues like poverty, with more universalistic ideas and systems of science. Prasanta Chandra Mahalanobis and his establishment of the Indian Statistical Institute in Kolkata in 1931 is a case in point. Trained in physics from Presidency College, then under the University of Calcutta, and later from King's College, London, Mahalanobis got interested in statistics after he was introduced to *Biometrika*, a British peer-reviewed journal on theoretical statistics. He is best known for his two works--- Mahalanobis distance, which measured the relationship between a point and a distribution (Mahalanobis 1936) and his methods for large scale sample surveys to measure the diverse population in the country. Yet, in this biopolitical move of governance of a population through measurement and statistics, there was "the possibility of using numbers for liberation rather than colonial control" (McOuat 2017: 847). Mahalanobis drew from Indian logic, especially the *Jaina* school to make connections between diversity of the Indian population and probability. He went on to become the chief architect of the second five-year plan in India in 1955, where he primarily used a neo-Marxian model of economic growth that formulated a different relation between capital goods and consumer goods than the first five-year plan. Mahalanobis's model proposed that in order to increase a higher standard in consumption, one has to first reach a higher investment in the production of capital goods. Whether it was Nehru crafting a vision for science in the newly independent nation or Mahalanobis constructing the economic architecture based on his conceptions of statistics and economics, the close involvement of scientists with national policy has been another characteristic that shaped both science and the nation in specific ways. Towering scientific figures like Homi bhaba, Meghnad Saha, Vikram Sarabhai, Shanti Bhatnagar, or MS Swaminathan in the recent past have been closely involved with steering scientific and economic policies and priorities in significant ways. This link between science, scientific actors, and nation building has been considered as the reason behind deterioration of independent scientific research in the country by several scholars because it institutionally separated research from higher education, processes that are otherwise deeply linked (Bhattacharya 2011).

Keeping this relation between science and the nation, in most of histories of science in India, "science is ideology to be unraveled and exposed--- as modernity and progress making or violence and oppression making--- depending on where you stand on the interpretive spectrum." (Phalkey 2013: 330). So, if on the one hand, there is a plethora of writing on the Nehruvian conception of science as the building block of progress, there is a parallel body of writing on the history of science in India that considers modernity, modernization, and science within it as "a continuation of state violence and stabilization of authority that had earlier characterized imperialism. This cluster of arguments has informed recent historiography, especially on dams, the nuclear question, population, reproductive health, irrigation, agriculture, and the Green revolution" (Phalkey 2013: 331). *Science, Hegemony, and Violence*, edited by Ashish Nandy, *Science, Development, and Violence: The Revolt against Modernity* by Claude Alvares, and *A Carnival for Science: Essays on Science, Technology, and Development* are examples of this line of argument. There is a third body of scholarship that takes a middle ground where science is neither celebrated nor criticized but is considered as more experimental, incomplete, and dialogical. Science, in this view, instead of already inhabiting ideological boxes with a pre-determined intention and outcome, is constantly emerging out of practices and exchange of ideas between different groups. It is more indefinite. For instance, in *Beyond Postcolonialism… and Postpositivism: Circulation and the*

Global history of Science, kapil Raj underscores the value of "circulation" in the creation of botanical knowledge towards the end of the seventeenth century through the coming together of different actors, networks of practice and knowledge, and ideas. In fact, he argues, that knowledge is built at these various junctures of circulation and inter-connection. He explains this through the example of a fourteen volume herbal of Indian plants mainly painted by Indian artists and commissioned by a French surgeon in Odissa. From "fakirs as depositories of herbal and medical knowledge to male and female collectors, illustrators, translators, bookbinders, and mediators", he shows that "being colonized and having agency are not antithetical" (Raj 2013: 343-44).

I find this emphasis on practice, networks, and inter-connections in science useful as I write this chapter on the relation between agricultural biotechnology and its place in larger debates about science, nation, and democracy in the country. Agricultural biotechnology, and biotechnology broadly, is intrinsically linked with national policy because it was conceived of and inaugurated by the Department of Biotechnology, under the auspices of the Ministry of Science and Technology, Government of India. The episode of agricultural biotechnology seems like yet another classic addition to the repertoire of nation building hybrid science initiatives undertaken by the central government over the past few decades. But as I show in this chapter, the introduction of the first and only legal genetically modified crop, *Bt* cotton, and later the conditions under which a moratorium was placed on the commercial cultivation of *Bt* brinjal in 2010 (aubergine or eggplant which is often called brinjal in Asian and South Asian countries), reveal how fractured both notions of science and the nation are. Not only did practices and networks of individual actors transform the future of agricultural biotechnology in significant ways, the processes around it brought critique and dissent at the heart of doing science and its relation with the nation.

This chapter is based on the archival research that I conducted at the personal archives of the biologist, policy maker, and founder of Center for Cellular and Molecular biology (CCMB) in Hyderabad, Dr. Pushpa Bhargava. I begin the next few sections by describing the difficulty of following any traces --- of people's actions, plans, and intentions--- because of the lack of enthusiasm on part of several of these actors to communicate with researchers and the extreme difficulty of accessing any government document. Bureaucracy in India is often about paper work--- these papers being both witnesses and bearers of truth, as well as, stacks of material that hide truth through multiple rounds of production, revision, and circulation. Perhaps for the same reason, these papers are forgotten and fiercely protected at the same time by bureaucrats and the government machineries alike, making it almost impossible for researchers to access them. Most of the documents that have been the scaffold for this chapter are reports produced by the DBT and the Genetic Engineering Appraisal Committee (GEAC), under the auspices of the Ministry of Environment, Forest and Climate Change (MoEFCC). There was a significant number of letters and newspaper articles in his archive as well. The history that I reconstruct here, therefore, is not against the grain because my analysis is based mostly on these government reports and not on the everyday practices of scientists and technicians, but by supplementing these reports with oral histories conducted with dr. Bhargava, CR Bhatia, The Secretary of the DBT who allowed for the collaboration between Monsanto and Mahyco, Jairam Ramesh, the Minister of Environment who conducted public hearings and placed a moratorium on the commercial cultivation of *Bt* eggplant in 2010, scientists in agricultural research institutes, and environmental activists like Vandana Shiva and Suman Sahai, and letters between state and scientific actors, I hope to add depth and texture to the narrative that is often hard to find though only official documents. In the following section, I show that biotechnology, unlike space or atomic research in the country, was more of *techne* rather than episteme from the very beginning of its conception in the early 1980s. By this, I mean that biotechnology has been considered a craft, with a practical goal of producing and disseminating biotechnological tools instead of producing scientific research and knowledge in the field. This is the most evident throughout the 1980s and 1990s when the main concern of the DBT was how to collaborate with the private sector to produce biotechnological tools at a national scale. In the last section where I narrate how the initiative of the then Environment Minister, Jairam Ramesh, led to several public meetings on the commercial cultivation of BT brinjal, I show how the nation, state apparatuses, and science are disjointed, shifting juxtapositions of ideas, decisions, and actions that are often opposed to each other, instead of solid blocks with coherent meaning and intention

Finding the Archive: My Meeting with Dr. Pushpa Bhargava

After spending more than a year in Durgaditya and Nuziveedu Seeds, I decided to conduct the last leg of my fieldwork with ministers and bureaucrats involved with GM technology, especially those working with the DBT and MoEFCC. The Review Committee on Genetic Engineering (RCGM) under the DBT and GEAC under the MoEFCC are the two central bodies controlling regulation of biotechnological goods in the country. RCGM is primarily responsible for conducting biosafety tests of GM products, whereas GEAC is the central authority that is responsible for granting permission for field trials or commercial cultivation of commodities like GM crops. One of the main critiques of the commercial release of *Bt* cotton that emerged in discussions during the decade of 2000s, was the fact that *Bt* cotton was released in the market by the sole intention of the DBT, without any approval from GEAC. The complex relation between these two units will be discussed later in the chapter.

I was also keen to understand the role of Indian research institutes, especially, the Central Institute of Cotton Research at Nagpur (CICR), and Indian Council of Agricultural Research in New Delhi. I was advised to meet with Dr. KR Kranthi, the then Director of CICR by several people while I was preparing to begin fieldwork and during it. I was prepared to face routine officialism and recognized the value of persuasion when it came to communicating with members of the government apparatus, but I was disconcerted with the impenetrable disinterestedness, often apathy, when I approached some of them for meetings. This, for instance, was the reply that I received from a Principal Scientist when I wrote to the Director of CICR for a meeting:

"On 19-Sep-2016, at 10:16 AM, ----------------wrote:

Your mail is being forwarded to Director for necessary permissions. I am afraid that you may not get the permission as the organisation gains nothing from your visit or thesis.

With warm regards,

(Name)

Principal Scientist

Crop Protection Division,

Central Institute for Cotton Research,

Post Bag No.2

Shankar Nagar P.O.,

Nagpur 440010"

My time of fieldwork, and in Delhi, were almost coming to an end and I was not satisfied with the patchwork of information that I had gathered after many telephone calls and brief meetings with bureaucrats and ministers in between their stacks of papers to sign and streams of visitors to attend to. Some of the interviews were engaged and useful but most of them were rhetorical, with the conversations beginning with an assertive, even aggressive, phrase like "we definitely need technology in agriculture...look at the rate at which our population is growing", but not moving far beyond that. In early November, I wrote to Dr. Pushpa Bhargava, an octogenarian scientist and founder of CCMB, well-known for his critique of biotechnology in India, with little hope of hearing back from him. To my surprise, he wrote to me immediately and agreed for a meeting. That was a day after Prime Minister, Narendra Modi, had announced demonetization of INR 500 and 1000 currencies. In a primarily cash economy like India, the withdrawal of these two denominations brought about utter chaos in the country that took almost a year to be resolved. These currencies were immediately taken off the economy but this deficit was not matched with currencies of other denominations. There were winding queues in front of banks and ATM machines that ran for a kilometers and people waited for a few hours, sometimes form 6 AM to noon, to withdraw cash. In the middle of this pandemonium, I booked my flight tickets with my debit card, borrowed a few hundred rupee notes from a friend who works with a bank, and left for Hyderabad to meet Dr. Bhargava.

My meeting with him was serendipitous for several reasons. First, I was at the tail end of my research and I was least expecting that an octogenarian, retired scientist would find my research important enough to meet. Second, once I reached Hyderabad and met him, I realized, that he had his own personal library where he preserved a few thousand documents--- letters from members of the DBT, past Prime Ministers, Nobel laureates, activists, journalists--- from the early 1980s until the recent past. I had planned to stay in the city for three days but I ended up living in his house for over a month. My knowledge about the history of biotechnology would be incomplete without this chance encounter. And, finally, the end of my fieldwork almost coincided with the end of his life. He started undergoing dialysis while I was there and breathed his last soon after I returned to the U.S. If not for this meeting, I would miss out on this significant intellectual presence in the history of agricultural biotechnology in the country, his invaluable archive that became the scaffold for this chapter, and the excellent story teller who narrated his meetings with the American biologist James

Watson or the display of superstition in matters of science with equal humor and conviction.

Bhargava has been a significant and contentious figure in the biotechnology landscape in the country. He was one of the first few scientists in the country who recognized the potential of biotechnology in the early 1980s and demanded the establishment of a separate Department of Biotechnology under the Ministry of Science and Technology. After completing his PhD in Chemistry at the age of 21 from Lucknow University in 1949, he worked as a research fellow for a few years in the U.S. and the U.K. --- at the Mc Ardle Memorial Laboratory of Cancer Research at the University of Wisconsin, Madison, and as a Welcome Trust Research Fellow at The National Institute of Medical Research, London. It was during this period that he became interested in the molecular approach to biology, and by the 1950s, he was a full-fledged biologist. "By the 1950s, I could see the biological revolution coming and I was drawn towards it, I wanted to be a part of it", narrated Dr. Bhargava in his feeble yet persuasive voice as we sat in his beautiful home, Anvesha, in Hyderabad. He founded the Center for Cellular and Molecular Research in Hyderabad in 1977. From the beginning of his academic career and public life, he advocated for the need to bridge arts and sciences, and for science to be transparent and socially responsible. Whether it was his colorful, intricately patterned cotton shirts, the corridors of CCMB that were dotted with rows of famous artworks, or his articles that were published in peer-reviewed journals in both natural and social sciences like Nature, Current Science, Economic and Political Weekly, his fusion of arts and sciences in both personal and public life was striking and unique.

As far as transparency in science and its social responsibility was concerned, he publicly critiqued the lack of transparency in funding scientific projects by the DBT, nepotism in Indian science, the lack of innovative research conducted by the research institutes, and the influence of a few scientists, whom he called the "scientific mafia", that hindered the growth of research within the country. Based on these grounds, he resigned from three academies that he was a part of, namely, Indian National Science Academy, National Academy of Sciences and Indian Academy of Sciences, as well as, returned his Padma Bhushan award (the third highest civilian award in India) in 2015. The main reason for returning the award was the shrinking space of dissent in the country under the then newly elected Bharatiya Janata Party (BJP) government.

Bhargava's enthusiasm to establish a separate department of biotechnology in the 1980s and his gradual disagreement with the workings of DBT and finally, vehement opposition to agricultural biotechnology as the Supreme Court nominee to the Genetic Engineering Approval (later Appraisal) Committee, in a way, mirrors the changing relation between science, nation, and democracy in the country. Moving beyond oral histories reflecting the "intersection of individual lives and histories", this chapter shows that "they enable us to trace the ways in which scientists themselves view the history of science and suggest ways in which we might interpret and integrate the experience of doing science into understanding its history" (Chowdhury 2013: 375).

Biotechnology as *Techne*: 1980-1990

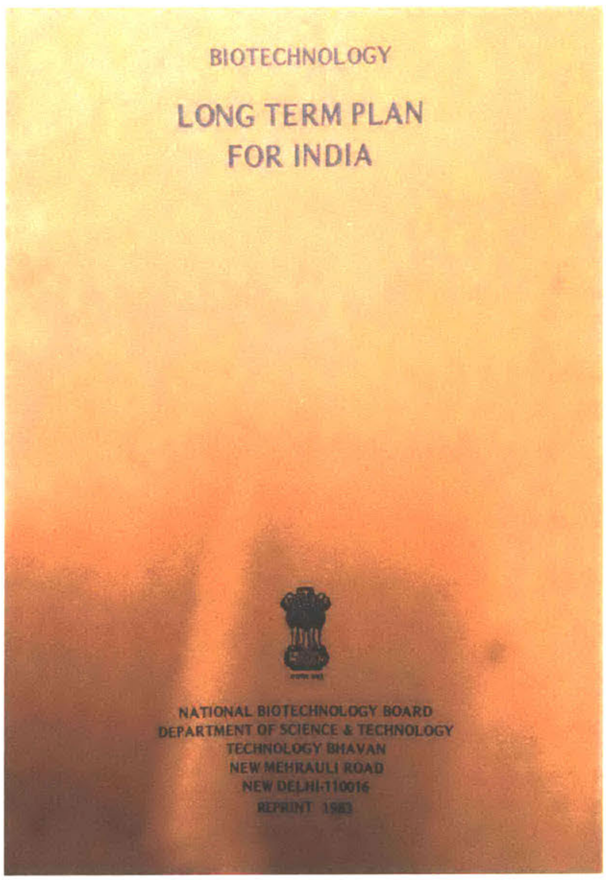
Techne is not only the etymological root of the word technology. As a concept, it is different from, yet related to, episteme or knowledge, where the distinctiveness of *techne* is the practical, material expression of a thought. It is a *craft* where specialized knowledge is required but only to address a problem or produce material manifestations of that knowledge. "Episteme denotes "understanding of a matter", or more generally, knowledge: *techne* on the other hand suggests actions, namely art, skill or workmanship, something not only conceived, but knowledge going into action." (Rawlins 1950: 389). During several dialogues between Socrates and Plato in *Charmides* and *The Republic*, medicine, farming, horsemanship, lyre-playing, housebuilding, pottery are considered as *techne*. The craft has a function in that it fulfils a goal. The goal of medicine is health or the goal of farming is food. The physician knows how to make someone healthy and this comes from his knowledge of medicine. For Plato, there is another aspect of *techne* and that is the larger goal of the welfare of the object. In *The Republic*, ruling is considered *techne*, where the goal is the welfare of the city. Even in the context of technology, this idea of goal oriented practical manifestation of a certain form of knowledge holds when it comes to the meaning of *techne*. In *The Question Concerning Technology*, *techne* is defined as: "a skilled and thorough knowing that disclosed, that was, as such, a mode of bringing forth into presencing, a mode of revealing" (Heidegger 1977: xxv). Unlike research on atomic and nuclear energy at the Bhaba Atomic Research center or in fundamental research in mathematics, biology and other natural sciences at Tata institute of Fundamental research, in biotechnology, the practical application of biotechnological tools has been the focus from the very beginning. There were efforts to create a base of inter-disciplinary scholars in biotechnology since the 1980s, but that was always within the larger context of disseminating biotechnology to the entire country. In fact, because the goal has always been the application of biotechnological tools, by the late 1980s, it was clear that the private sector needed to be brought into the ambit of biotechnology as the research institutes would not be capable of producing at a scale that would cater the entire nation.

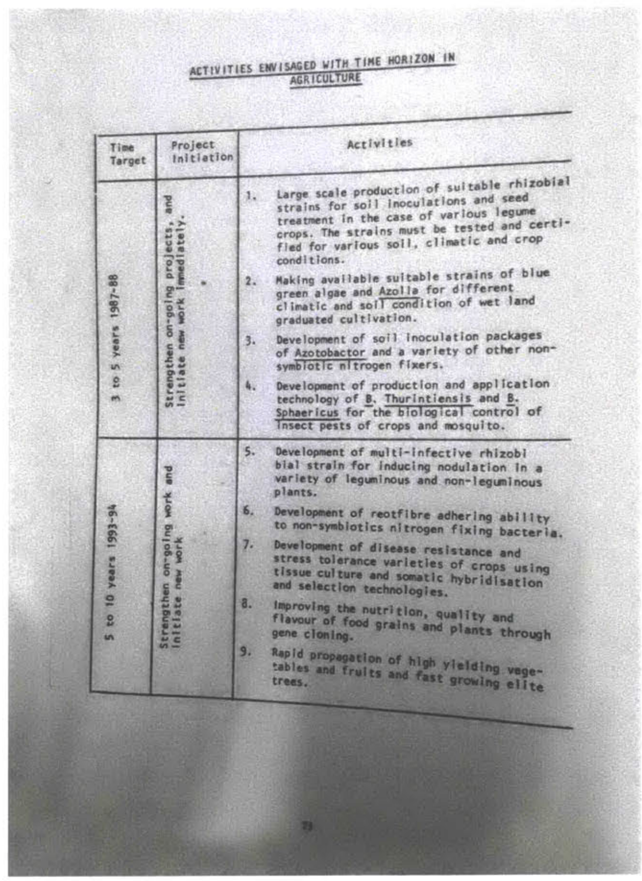
Discussions around the urgent need for the introduction of biotechnology, especially in medicine, began in earnest by the mid-1980s in India. Simultaneously, a need was felt to start a department under the auspices of the central government that would be solely devoted to all matters around biotechnology including research, use, and regulations related with biotechnological objects. Scientists like Pushpa Bhargava, MGK Menon, and MS Swaminathan were at the forefront of the march towards introducing biotechnology in the country. Mr. Rajiv Gandhi, the then Prime Minister of India, opined about biotechnology thus: "unless we leap forward, there is no way of catching up with the rest of the world" (http://www.dbtindia.nic.in/creation-of-dbt/). Scientists like MS Swaminathan, whose name has been inextricably linked with the Green Revolution in the country, had proposed the formation of the National Biotechnology Board (NBTB) under the Department of Science and Technology (DST), instead of forming a full-fledged department dedicated to biotechnology. NBTB was formed in 1982 but within a few years, it was clear that the Board had not made significant progress in the field due to lack of funds and autonomy (Bhargava: 1995). In 1985, a few scientists, including Bhargava, appealed to the Prime Minister for the establishment of a separate Department of Biotechnology, the focus of which would be research, development, and production. After much deliberation between the Prime Minister's Office and a coterie of scientists in the country, The Department was finally established in 1986. The research areas where biotechnology could play a significant role were "genetic engineering, immunotechnology, tissue culture, enzyme-based technologies, plant based indigenous drugs, alcohol production from non-conventional sources (such as grass), and new biology based energy technologies such as energy plantations using genetically engineered plants" (Bhargava: 1995).

In the early years of setting up a separate department for biotechnology, the two overarching concerns of the government were the administrative structure that DBT would assume with a clear goal for future, and safety and regulation that were to be adopted around agricultural biotechnological research and commercialization. Once the need for a separate department was finally formed, "there were inter-departmental conflicts with no department willing to part with its earlier responsibilities to a new but specialized body." (http://www.dbtindia.nic.in/creation-of-dbt/). Along with problems that one usually expects in forming any new department like bureaucratic delays, determining administrative division of labor, procuring scientific equipment, and allocation of funds, the DBT faced an added obstacle of being unable to persuade the private sector to collaborate early on. This was mainly due to the long time that most government procedures take in India. Further, there were ongoing discussions within the scientific community about the vision and future goals of the newly formed Department. Research-cum-production and creating a regulatory framework emerged as the immediate goals after deliberation among the few scientists who were working on biotechnology at the time.

"Biotechnology: Long Term Plan for India", prepared by the National Biotechnology Board and printed in 1983, begins with highlighting the need to strengthen inter-disciplinary scientific base between biology, chemistry, physics, mathematics, and engineering to create various biotechnological applications and products. Within biotechnology, genetic engineering, immobilized biocatalytic systems, cultivation of animal, plant, and microbial cells, development of fused cell techniques, and process and systems of bioengineering were considered as the important areas of research. Biotechnology was also recognized as a field that could forge the "joint working of scientists and technologists from universities, research laboratories and industries for developing high technology based industrial process with tremendous economic potential" (page 2). In a pre- liberalization economic and academic context, this recognition of the lack of collaboration between disciplines and public/private institutions and the subsequent goal of inter-disciplinary research and government-industry partnership seem unprecedented. The plan proposed a joint commitment from academic funding institutes as well as research institutes like University Grants Commission, the Science Academies, and appropriate governmental bodies to revamp the education system that would prepare young scholars to conduct research in biotechnology. As far as the collaboration between research and industry was concerned, the long-term plan proposed to compensate through tax write-offs and deductions for R&D investments.

Health, agriculture, energy, environment, and industry were the areas where research and application of biotechnological tools were proposed for the next ten years. Whereas development and production of new products like new vaccines for polio, measles, and leprosy, antibiotics, and interferons were the immediate as well as long term goals in the health sector, in agriculture, the approach seemed more oriented towards research to address the immediate problems faced by several crops.





ACTIVITIES ENVISAGED WITH TIME HORIZON IN AGRICULTURE

Time Target	Project Initiation	Activities
3 to 5 years 1987-88	Strengthen on-going projects, and initiate new work immediately.	1. Large scale production of suitable rhizobial strains for soil inoculations and seed treatment in the case of various legume crops. The strains must be tested and certified for various soil, climatic and crop conditions. 2. Making available suitable strains of blue green algae and Azolla for different climatic and soil condition of wet land graduated cultivation. 3. Development of soil inoculation packages of Azotobacter and a variety of other non-symbiotic nitrogen fixers. 4. Development of production and application technology of B. Thurintiensis and B. Sphaericus for the biological control of insect pests of crops and mosquito.
5 to 10 years 1993-94	Strengthen on-going work and initiate new work	5. Development of multi-infective rhizobi bial strain for inducing nodulation in a variety of leguminous and non-leguminous plants. 6. Development of reotfibre adhering ability to non-symbiotics nitrogen fixing bacteria. 7. Development of disease resistance and stress tolerance varieties of crops using tissue culture and somatic hybridisation and selection technologies. 8. Improving the nutrition, quality and flavour of food grains and plants through gene cloning. 9. Rapid propagation of high yielding vegetables and fruits and fast growing elite trees.

Soil fertility, development of new varieties, photosynthesis, forestry, and food were the five sub areas under agriculture. Developing varieties of crops that would be tolerant to salinity, alkalinity, disease, and drought through tissue culture and somatic hybridization, were the primary areas slated for research.

By the end of the 1980s, the DBT had a clearer agenda for the research and use of agricultural biotechnology. Instead of building an inter-disciplinary generation of scientists who would pursue research in biotechnology, the focus shifted toward identifying specific problems faced by the plants and finding solutions to those problems through agricultural biotechnology. Within the broad field of plant molecular biology and agricultural biotechnology, 5-10 projects were identified based on the needs of certain plants within a fixed time. Within agricultural biotechnology, development of disease and pest resistant strains of plants gained precedence, followed by the exploitation of heterosis using biotechnological tools and shortening the breeding cycles and increasing selection efficiency. The possibility of the use of *Bt* genes in plants to resist pest attacks was also considered for the first time based on the already proven results of the efficiency of *Bt* toxins to resist insects belonging to Dipteria, Lepidoptera, and Coleoptera classes in other countries.

As one reads through the agenda reports of the decade, one notices a consistently present tension between the lack of expertise in the country to undertake the large-scale research that was envisioned at the time and the urgent need to use biotechnological tools to address problems like pest attacks that destroyed crop yields significantly. The inadequacy of infrastructure and sophisticated technology to carry out research around biotechnology emerged as an impediment to realize the grand visions that were painted towards the end of the end of the 20th century. An endnote of the "Report of the Task Force on Plant Molecular Biology and Agricultural Biotechnology, 1988" states, "As the task force felt that its competence was not enough for judging this specialized field, the Chairman authorized Dr. B.B. Biswas to consult specialists in the area…" (33). The same report repeatedly mentions the need for Human Resource Development (HRD) through teaching and practical training in core subjects that would emphasize the basic concepts in plant molecular biology. For instance, the rapid cycling populations of brassica were chosen as convenient materials for classroom teaching.

By the beginning of 1990s, members of the DBT recognized partnership with industry as a prominent means to overcome the lack of infrastructure and expertise in the field of agricultural biotechnology and plant molecular biology. With the economy slowly adopting neoliberal policies, the DBT promoted the formation of science-industry consortium that would "advice the Government in many ways regarding various procedures that need to be simplified, reduction in unnecessary regulatory measures, monitoring etc."[6] Recognizing that the resource position that were required to be

[6] See Agenda Papers for Second Meeting of Reconstituted SAC-DBT on 11-6-1991

invested in successful implementation of agricultural biotechnological tools were insufficient, the report refers to the 8th 5-year plan that highlighted the importance of collaborating with industry to "formulate bankable projects (that would) bring in financial institutions and industries to support major efforts" (ibid). Scientists like Dr. Parvinder Singh, of Ranbaxy Ltd., New Delhi, and Dr. R.A. Mashelkar, Director, National Chemical laboratory, Pune who were present at the meeting pointed out that there should be "mutual trust" and "mutual appreciation" between the government and industry to use biotechnology to ameliorate the conditions the poor and disadvantaged sections of the population "who do not have the awareness to benefit from science". The Biotech Consortium India Ltd. was inaugurated by the then Prime Minister, V.P. Singh, on 20th December 1990, which was a joint enterprise between financial institutions, industry, R&D laboratories, and the government. This was the first step towards creating a science-industry consortium in the country. In the initial proposed budget, a sum of 5 crores was allocated as the capital base of the Consortium out of which 4 crores would be provided by financial institutes like IDBI, ICICI, and 1crore would come from industry. As a broker between science and the market, the main scope of the Consortium would be to identify "need based technologies" and products that were being developed in scientific laboratories across the country and take charge of making those technologies as viable products in the market.[7] The work of

[7] For more details, see, the report on "Science Technology Consortium in Biotechnology"

the Consortium to convert technologies into commodities and products would be guided by cost-benefit analysis and feedback from the market to "minimize investment of risk capital".

As the discussions in India were inching towards a stronger partnership between the government and industry, in several international circles, there were emerging concerns about the application of biotechnology in the third world, especially if it was done for earning profit by multinational companies. At the "Biotechnology and the Third World: A Round Table Discussion", organized by the Council on International and Public Affairs, New York, in 1983, a diverse group of scientists, lawyers, academicians, and UN members, expressed concerns about the need for "increasing access of the Third World to biotechnology on equitable terms and tracking the social and economic consequences of the introduction of this technology into developing countries, especially for the poor". [8] The main pitfalls of privatization in this case were "Northern domination" and the problem of selling biotechnological tools and products for profit. The participants pointed out that the development of products in the industrialized countries would imply the transfer of these technologies to the less industrialized nations, without taking the latter's specific needs into consideration. The patent laws in

[8] For more details, see the Report "Biotechnology and the Third World: A Round Table Discussion" published by the International Center for Law and Development, Council on International and Public Affairs.

place on several of these products, the transfer of technology and its further development and use would be based on the terms and conditions of the developed nations, leading to a northern domination that already existed in case of several other technological objects or knowledge. The northern domination would also reflect on the use of germplasm and genetic resources from the developing countries to create products for the developed nations. Second, some of the participants pointed out that unlike the Green revolution where most of the basic and applied research were conducted by the public sector, since most research in biotechnology was undertaken by for-profit organizations, areas that would not accrue profit would be overlooked by the companies. The other side of the debate argued that unless private companies were involved, it would be impossible to disseminate biotechnological products to the various parts of the world--- a market that seemed too enticing to miss.

The Question of Risk around Biotechnology in the U.S. and India: A Brief History

Another reason that added to the precariousness of biotechnology in the developing world was the lack of clarity on assessment of risk associated with biotechnological research and tools. The unintended consequences and environmental risks of using GM products were already being debated and discussed in the U.S. since the 1970s during the early years of rDNA research. Chemist Erwin Chargaff described the invention of DNA and later rDNA as "the two greatest deeds—and probably misdeeds—of science in my time" (Chargaff 1976:32). The specter of doubt was triggered when Janet Mertz, a student of biochemist Paul Berg at Stanford University, proposed an experiment which involved inserting the DNA of an SV40 virus into Escherichia coli (E coli) or K12, a bacterium residing in human intestines. When biologist Robert Pollock heard about this proposal, he protested due to the perceived risks involved in using E coli. Pollock opined, because the bacterium is intimately linked with human bodies, genetic modification could turn this otherwise harmless bacterium into a pathogen, which would be harmful for the environment. Or, inserting new DNA into K12 could also inadvertently produce other kinds of pathogenic bacteria (Wright 1986: 594). The experiment was finally cancelled following similar concerns from a large segment of the scientific community. Throughout the 1970s important conferences and heated debates took place around the possibility of unintended consequences and risks involved in bringing together two unrelated strands of DNA through recombination. How could one reach the conclusion that two harmless DNA, when brought together, would not result in pathogens harmful for the organism? How bounded could the intended consequences be in gene splicing? Moreover, could consequences—intended or unintended—necessarily be predicted in every case of gene splicing? In other words, some of the primary issues debated in the conferences were: the safety of the scientists practicing gene transfer; the ecological and environmental effects including toxicity, pathogenicity, weed formation if rDNA organisms escaped from laboratories; and what would count as 'biohazard' (Wright: 1986, Krimsky: 1988, 1991, 1996, Jasanoff: 2005). These issues were discussed in three major scientific meetings held in Bethesda, Maryland, Falmouth, Massachusetts) and Ascot, England between 1976 and 1978 (Wright: 1986).

However, the conferences that had a long-standing impact on all regulatory and legal developments in the entire world related to field trials, patenting, and use of GM objects in the 1980s and later, were the two Asilomar Conferences, held in California in January 1973 and February 1975. The first was specifically about the kinds of experiments that could cause biohazards and therefore, what could possibly be the regulations that would prevent biohazards. After the conference, Paul Berg wrote a letter to the National Academy of Science (NAS), the famous "Berg et al" letter, which charted out a variety of experiments that did not pose major threats, and three specific kinds that could potentially be risky. These three types of experiments used toxic, drug-resistant and cancer genes in E coli[9]. The letter resulted in a moratorium on all rDNA experiments until the potential risks could be properly measured (Bareikis: 1978).

The first Asilomar conference and its aftermath laid the groundwork for the second, and the more elaborate one, held in February 1975. This second iteration included

[9] There are videos on the letter and Asilomar conference at www.dnalc.org

several renowned biologists, lawyers and reporters. There were fifty-two representatives from fifteen foreign countries, including a delegation from the USSR (Bareikis: 1978). The conference was critical because it moved away from the conventional paradigm of scientific research as a bounded laboratory practice and established the possible risks associated with rDNA research and the larger society. The politics of science came in direct dialogue with ethics of intervention and social accountability. As attorney Daniel Singer pointed out, "the risks were not only scientific but social… proponents of risky experiments have the burden of demonstrating that the risks are trivial or that the benefits are certain and overwhelming" (Bareikis 1978:7).

By the end of the conferences, although the risks associated with the use of rDNA were widely recognized, there were heated debates and differences about the guidelines that would restrict rDNA research. On one side of the debates, biologists such as David Botstein, for instance, pointed to the risks of not having strict guidelines. Botstein argued, "the prizewinning scientists of the world are not the only ones who will do the experiments. Ten years from now genetic engineering kits might be standard equipment in high school classes" (Weinberg 1975:196). Similarly, bacteriologist Mark Richmond defined the conference as "the end of the age of innocence", emphasizing that science had a responsibility to society to not expose it to "non trivial risks" (Weinberg 1975:149). On the other side, there were those who argued for the freedom of inquiry in scientific practice and insisted that regulations should never be restrictive to free inquiry.

The overarching need for regulation resulted in the formation of Recombinant DNA Advisory Committee (RAC) in 1974, followed by the NIH Guidelines on rDNA research, which was published in June 1976. The structural logic on which the Guidelines were based was that of upper and lower bounds of risk (Krimsky: 1984). The upper bound included the riskiest procedures and required more regulations than less risky procedures captured in lower bounds. Several experiments were graded as falling in between the two poles. This hierarchy of risks was based on phylogenetic-ordering principle, where the closer the donor organism is to humans, the greater the risk attached with the DNA transplant (Krimsky 1984:184). The main critique of the NIH guidelines was of a linear approach, where organisms were categorized in a hierarchy based on their structural affinity towards humans, which completely determined the probability of risk. Therefore, risk itself was brought within the realm of predictability, leaving no scope for inadvertent or unintended consequences: "the probability of non linearity in the production of hazards was considered remote, as in the case where two relatively innocuous segments of DNA would produce something dangerous. The reductionist thesis proclaimed that 'from non pathogens, pathogenesis will not emerge" (Krimsky 1984:191). The scientists who were opposed to strict regulations were more or less satisfied with the regulation and eventually pushed for further deregulation. But there were some members within the community who were not convinced about the linear approach adopted by NIH, especially the doctrine of substantial equivalence.

India certainly lacked any robust debate about the unintended consequences and risks associated with agricultural biotechnology before importing the *Bt* technology from the U.S. As I show in the next section, large scale public debates around agricultural biotechnology began *after* the first few years of the cultivation of *Bt* cotton. Not only was this lack of discussion in scientific and public forums was one of the primary reasons for doubt around biotechnology among environmental activist groups, farmers' organizations, the introduction of GM cotton constructed a new chapter around environmental risk, a discourse that was unprecedented in the context of agriculture in the country. The two bodies that are responsible for regulation around biotechnological products in the country are the RCGM and GEAC. The former conducts all the scientific tests on GM products whereas the latter is responsible for clearing field trials and commercial cultivation of GM crops. The field trials of *Bt* cotton received approval only from RCGM and not from GEAC because adequate time was not given to the sequential processes of laboratory testing, field trials and commercial sale of the seeds (Shiva, Emani and Jafri: 1999). Further, RCGM being a part of the DBT, a body that has publicly supported biotechnology consistently, is impartial and inadequate for carrying out biosafety tests on GM products. After the DBT was formed and throughout the decade of 1990s when discussions about the possible ways of collaboration between research institutes and industries were going full-fledged in the country, the Recombinant DNA Advisory Committees were set up to provide guidelines for risk assessment and regulation associated with biotechnological research and products. Although there were attempts to consider risk or safety around biotechnology as a critical area of research to measure its possible impacts on human health and the environment, the committees increasingly considered risk assessment as a task that needed to be completed before commercial release and use of genetically modified products. In a 1991 draft of the safety guidelines prepared by the advisory committee, this issue becomes clear: "In fact, the single most concern of the group was how to bring out regulation, yet not inhibit the growth of genetic manipulation work in the country that would lead to useful and safe commercial products."[10] In one of the earliest reports on safety regulations for rDNA research in 1983, most of the regulatory measures were renderings from the "NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules", 1976. There were, however, a few points that were different from the NIH Guidelines. First, the report does not already follow the principle of "safe until proven risky" that was the guiding principle of the NIH report. It acknowledges that although there was clarity about the lengths of DNA sequences in a gene, the consequences of

[10] Recombinant DNA Advisory Committee, 1991. "Draft Safety Guidelines for R&D & Production"

such reshuffling of genes during growth and further alterations in the new sequences were still unclear, especially when the end product would be meant for ecosystems like the human gut. "Strains suitable as recipients in rDNA technique and also endowed with suitable biotechnological potentials may run into cross purposes of safety on the one hand and faster growth rates and turn over of the product on the other. The risks associated with such essential developments are yet to be established. Hence, the avoidance of certain highly dangerous systems (potent toxin producing genes) and systems where no normal genetic exchange is known to occur, to minimize the hazards, just in case."[11] The report further points out specific issues like the lack of maintenance of personal hygiene among large sections of the population, sufficient waste disposal systems, and adequate water supply that would increase the possibility of environmental risks in ways different from countries where these infrastructures are more developed. Other than some of these initial reports, discussions about risk and safety are surprisingly absent in agenda meetings of the Scientific Advisory Committee meetings throughout the 1990s. There were repeated discussions about the need to have focused, goal oriented thrust areas and projects, considering the limited resources of the DBT, the need to curb bureaucratic delays in giving clearances to imported machines, to address the issue of lack of trained students wo would be capable of

[11] Recombinant DNA Research. 1983. Safety regulations for India. Report of the Recombinant DNA Advisory Committee. National Biotechnology Board. Department of Science and Technology

undertaking research, and most importantly, the kind of collaborations with industry that were urgently needed to produce biotechnological tools more efficiently.

The Introduction of *Bt* Cotton: The Fragmented "Nation"

It was a sultry summer of 1993 in India. The country was waking up to the economic liberalization that had begun two years earlier. A group of scientists from the DBT, had recently started to negotiate with Monsanto, the U.S. agricultural company, about the possibilities of the transfer of *Bt* technology to India. After the government had refused to purchase *Bt* seeds from Monsanto a few times earlier, Dr. Chittaranjan Bhatia, the newly appointed Secretary of the DBT, visited the U.S. towards the beginning of the year to discuss the matter further. Soon after, in the month of June, a team from Monsanto landed in India to make a presentation on this patented technology. The room at was packed with scientists from the DBT and the Indian Council of Agricultural Research (ICAR), the apex body controlling agricultural education and research in the country. Most of them were in favor of adopting the technology to Indian agriculture but did not consider Rs. 60 lakh as a suitable price for it. That scale of investment in the field of agriculture was inconceivable by scientists and members of parliament alike at the time. In fact, during the Green Revolution years, most of the hybrid dwarf wheat and rice had reached India through various aid programs from the U.S., and therefore, all of them were acquired without any cost. Further, most of the research and distribution of hybrid seeds during the Green Revolution were performed by public funded research institutes in the country, without any involvement of the private sector.

Dr. Bhatia, who had acquaintances in Mahyco, one of the older agricultural companies in the country with significant presence since the Green revolution years, urged them to strike a deal with Monsanto as the government was not prepared to expend on the technology. Mahyco grabbed the opportunity and soon after, one hundred Cocker 312 seeds with *Bt* genes were imported to India from Monsanto. ICAR expressed their concerns about Mahyco directly importing seeds into the country without going through the already set procedure of moving through the National Bureau of Plant Genetic Resources (NBPGR). Mahyco contended that if the seeds were imported through NBPGR then any Indian seed company would be able to access the seeds despite them paying a hefty sum to purchase the technology from Monsanto. In the end, Dr. Bhatia approved the import of seeds directly by the company:

"I felt the company would do a better job of actually taking the technology to the field than any of the government institutes. Once we refused the technology, we started funding six agricultural institutes to come up with *Bt* technology indigenously but it did not really work out. Of course, this was not really following the procedures and I was later told by Dr. Manju Sharma (the Secretary of the DBT who succeeded me) that she had to give a lot of explanations about why this was allowed. I knew that technically ICAR should have been involved in the procedure of obtaining the seed and NBPGR is the correct one. But, at the same time, I knew that they were also apprehensive that if the seeds came through NBPGR, there was a possibility that someone else would be able to access it. It would not be exclusively for Mahyco and since they had paid so much money, naturally they liked the exclusivity. Later on there were many questions on this and Manju Shrama had to deal with them.", narrated Dr. Bhatia as I tried to excavate the pre-history of *Bt* seeds that is rarely available for public discussion, as we sat in his Mumbai residence one afternoon in mid-December.

This one decision and the introduction of GM seeds in the country was indeed a transilient move in the otherwise languid landscape around biotechnology during the last two decades of the 20^{th} century. Let alone any public discussion around this decision that would eventually transform the discourse around agriculture in the country for the next two decades, most people like scientists working with the DBT, ICAR, or NBPGR, environmental activists, agricultural organizations, and the larger public had no information about the decision until after the first few years of cultivation of *Bt* seeds. Dr. Bhargava was one of those scientists who did not know about the decision until towards the end of the 1990s, a few years before the commercial release of

Bt cotton in 2002. Lamenting about the exclusive, even fraudulent process of introducing GM seeds in the country, he described the decision as "unacceptable in that dark period in history in the country". A senior scientist at NBPGR who requested to be anonymous commented that "they stole the seeds into the country" during one of our conversations about the process of importing biological material within Indian borders.

Although there were increasing efforts from the central government to collaborate with the private sector to bring biotechnological tools to the Indian market at a large scale since the beginning of the formation of the DBT, the decision to purchase the *Bt* technology from an international agricultural giant like Monsanto, began the episode of GM cultivation in the country on a sour note. The formation of Monsanto-Mahyco Biotech in 1998, a joint venture company in which Monsanto owned 26% share, transpired at a time when India was already facing criticism from the civil society for the neoliberal policies of the government. As a result, soon after the first few seasons of the cultivation of *Bt* cotton, most of the critique in the public sphere were rooted in mistrust on the central government about this collaboration that went hand in hand with misgivings about neoliberal policies that perhaps allowed the merger to happen in the first place. Indian science and the credibility of Indian scientists were seriously questioned. In a series of emails sent to several scientists and environmental activists in the country by the environmental activist and eco-feminist, Dr. Vandana Shiva, in June, 2001 with titles like "campaign Against Biopiracy", "Globalization and the Destruction of Food Security", and "Which Road to Qatar? Food First or Export First", she addresses this issue of the effects of globalization on agriculture and considers this as the main reason for increasing food insecurity in the world, especially the Third World. She mentions three direct ways in which globalization exacerbates the food security of nations where large percentage of people are directly and solely dependent on agriculture for their livelihoods: increasing cost of inputs like seeds, fertilizers, pesticides that drain the income of farmers in significant ways, the overall decline in food production because of the shift from staples to cash crops, falling farm prices because of the decreasing subsidies to the farmers and the withdrawal of Minimum Support Prices for most crops, and finally, the removal of import restriction and the dumping of imported, subsidized agricultural produce in the Indian markets. To substantiate these points, she adds, from 1960-61 to 1998-99, there has been a substantial decrease in the area of production of nutritious grains (often called "course grains" because of the bias for wheat and rice) from 45 million hectares to 29.5 million hectares and the area under cotton increased from 7.6 million hectare to 9.3 million hectare. She further provides examples of farmers producing coconut, coffee, and pepper corn who suffered significantly due to the subsidized imported products from other countries. In an "Open Letter to members of the TRIPS Council", she questions: "If non-essential products like "wines" and "spirits" can be protected under Article 23 of TRIPS, why are the seeds, plants, and medicines produced by the Third World countries unprotected? This is a glaring inequality and injustice—and if not corrected it threatens the very survival of millions of peasants who will be denied the right to seed and millions of the hungry and diseased who will be denied the right of food and medicine" (Email dated 19th June, 2001).

The decision to buy the technology from Monsanto, an agrochemical and agricultural biotechnological company, with a history of producing several carcinogenic chemicals like polychlorinated byphenyls (PCBs), aggressively protecting their patents by suing

r-DNA debate needs much more seriousness

While drawing similarities between natural HGT in microbes and laboratory experiments, Dr. Natarajan ought to have told the other half of the story as well. For it is this very mobility of the transgene construct that increases the probability of horizontal transfer beyond what is intended or desired.

I WRITE in response to the article by Dr. C. Natarajan (The Hindu, June 19). I tend to agree with him that the debate on the r-DNA technology has been "too clever by half". Sadly, his own piece proves no exception. The debate has been notable for the way scientists hired by mega agri-business es have risen to the blind defence of a technology which promises to earn unprecedented profits for their companies. I write to keep both the scientific conscience and scientific temper alive about a technology that could be potentially hazardous to life on earth.

"Horizontal gene transfer, a fundamental procedure involved in r-DNA technology, happens all the time in nature in every organism"

This is a baseless assertion concocted by piecing together a string of half-truths. Nature would not be what it is today if this statement were true. The learned scholar has provided a number of examples of horizontal gene transfer (HGT), which are all in the nature of exceptions that only go to prove the rule of vertical gene transfer in Nature. HGT in Nature happens only in exceptional cases, only some of the time.

"There are innumerable studies that show similarities between natural horizontal gene transfer and natural DNA rearrangements, and those used in laboratory experiments...the plasticity of the genome has been established in every organism examined."

This is well known but is mainly true in the case of microbes. This is what enables pathogenic bacteria and viruses to invade and infect all kinds of organisms, causing various types of diseases. And, precisely because of this mobility, their DNA has been utilised by genetic engineers as vectors to smuggle' transgene DNA across kingdoms. It is noteworthy that despite the occurrence of mobile elements, cases of such inter-generic gene transfers between higher organisms in Nature are statistically insignificant.

While drawing similarities between natural HGT in microbes and laboratory experiments, Dr. Natarajan ought to have told the other half of the story as well. For it is this very mobility of the transgene construct that increases the probability of horizontal transfer beyond what is intended or desired, be it the transgene, the CaMV 35S promoter or the antibiotic resistance gene.

Several cases of HGT, which are hazardous, have been reported. Thus, some studies have demonstrated that plant viruses can acquire viral genes from transgenic plants. In a transgenic mustard (Brassica napus), the introduced translation activator gene (required for protein synthesis) recombined with the complementary part of the same virus without that gene, and led to infectious viruses in 100 per cent of the transgenic plants (Lommel S. A. and Z. Xiong, J. Cell. Biochem. Vol. 15, 1991). Similarly, a tobacco species (Nicotiana benthamiana) was made virus resistant by the usual method of incorporating in its genome the Cowpea Chlorotic Mottle Virus (CCMV) coat protein gene. This gene recombined again with a defective avirulent virus without this gene, leading to a reinduction of virulence (Green A. E. and R. F. Allison, Science, Vol. 263, 1994). One viral sequence is practically present in all first generation transgenic plants, the CaMV 35S promoter (Cauliflower Mosaic Virus). Recently, Kohli et al. (The Plant Journal, Vol. 17, 1999) reported a recombination 'hot spot' in this promoter which means that this DNA can break and join up with other pieces of viral DNA. Thus, GM and non-GM virus mixes can lead to creation of deadly viruses, especially CaMV, which being similar to HIV and Hepatitis B, can pose immense dangers. Cases of genetic pollution due to HGT through pollen dispersal have also been reported (Klinger et al., Am. J. Botany, Vol. 79, 1992 and Skgosmyr L. Theor. Appl. Genet., Vol. 88, 1994).

Textbook information

"The use of marker genes of r-DNA work has been marauded by the ignorant with claims that they are antibiotic resistant genes and that this creates the spread of antibiotic resistance... the half-life of plant genomic DNA is extremely short"

The use of antibiotic resistance genes as markers in the case of plasmid DNA vectors to detect successful gene insertion is textbook information. Initially, Kanamycin resistance genes were selected as they were considered harmless, the antibiotic Kanamycin being rarely used. However, there are reports of this gene conferring cross-resistance in bacteria against clinically important Kanamycin-related aminoglycoside antibiotics (Smirnov V. V. et al., Antibiot Khimiotic, Vol. 39, 1994; Onaolapo J., Afr. J. Med.Sci., Vol. 23, 1994). Possibilities of the transfer of this gene from food/animal feed to gut bacteria have also been reported (Mackenzie D., New Scientist, Jan 30, 1999).

Dr. Natarajan is right in saying that the half-life of plant genomic DNA is extremely short. But this is of no relevance here. For the antibiotic resistance gene is not a part of the plant genomic DNA, but is a section of the pathogenic bacterial extra-chromosomal plasmid DNA, integrated into the host genome as a part of the transgene construct. These DNA are designed by Nature to be relatively stable, to enable infection. Therefore, the assertion of the author about the impossibility of the spread of antibiotic resistance through HGT of this gene does not carry conviction.

"... the new technology is no different from the classical one save that it is more precise, more accurate..."

This contention, oft repeated by endorsers of r-DNA, is very far from the truth. Gene function in Nature is tightly controlled so that the right proteins are made in the right place, time and quantity. One does not find kidney functions in the brain or food proteins in leaves and vice-versa. In Nature, crossbreeding takes place between very closely related species. In traditional breeding also, different variations of the same genes in their natural context are exchanged. This preserves the tight genetic control, which is vital for the proper growth of an organism. In marked contrast, r-DNA technique involves isolation, cutting, joining and transfer of single or multiple genes across kingdoms, circumventing natural species barriers. For example, tomatoes have been developed which contain an 'anti-freeze' gene from Arctic fish, part of a plant virus (CaMV) to 'switch on' the fish gene and an antibiotic resistance 'marker' gene from bacteria. All this for greater tolerance to frost. The technique is imperfect as the efficiency of incorporation is low, and the introduced gene randomly incorporates in the DNA of the host. This leads to a disruption, to some extent, of the tight genetic control and balanced functioning, which is retained through conventional cross breeding. Thus, from the standpoint of basic principles of genetics and its own constraints, r-DNA technology is neither more precise nor a natural extension of traditional cross breeding methods.

Indeed, Finnegan and McElroy (Biotechnology, Vol. 12, 1994) have shown that transgenic plants are unstable, generally do not breed true and that 'silencing' of the transgene can also occur. Further, it has also been reported that the same cellular mechanism involving the integrase-disintegrase enzyme complex that allows insertion of the transgene at a site, can also make it jump out and reinsert at another site (Asante-Appiah E. and A. M. Skalka, Antiviral Research, Vol. 36, 1997).

"...glyphosate is non-toxic to mammals and fishes..."

This is not necessarily true. Monsanto's glyphosate destroys earthworms, mycorrhizal fungi, and other micro-organisms in nutrient cycling in the agro ecosystem (Van der Heijden et al., Nature, Vol. 396, 1998). In such situations, further secondary effects on other organisms of the ecosystem can be expected. Several broad spectrum herbicides, and the routinely mixed inert solvents and detergents, before spray, act synergistically to induce eye irritation, skin-irritation, vomiting and cardiac depression amongst workers in the short term (Howard V., The Ecologist, Vol. 27, 1998), and testicular cancer, reduced sperm count in the long term (FAO-WHO Report, 1986).

Pest resistant crops

"...r-DNA technology does not harm the environment or cause risk to the biodiversity"

An 'eco-friendly' innovation of genetic engineering has been the production of pest resistant crops, the most popular being Bt cotton. Bt cotton and other such transgenic crops make their own pesticides. The transgenic crop has the toxin gene Bt derived from a bacterium, Bacillus thuringiensis, which produces the pesticide that kills the cotton boll-worm. Sprays of this bacterium were used in the U.S. to control boll-worm infestation of cotton. However, experience has shown that for such control, pesticides of ever increasing potency had to be used, commensurate with the rising pesticide resistance of the boll-worms. The claim was that with such crops, pesticides would not have to be sprayed, coupled with the unrealistic hope that the pests will not develop resistance! But there are reports that the pests have become resistant to even multiple forms of Bt [illegible] (Ahmad D. N. and D. A. Andow, [illegible], Vol. 268, 1995). As a consequence, farmers had to mix Bt crops with non-Bt crops to create 'refuges' for reduction of selection pressure on [illegible]. The refuges allow some susceptible worms to survive and multiply. Otherwise, the whole pest population would become Bt resistant ([illegible] B.E., Proc. R.Soc. London, Vol. 255, 1984 and Ann. Rev. Entomol., Vol. 39, 1994). So the farmer, much to his dismay, and much to the advantage of the seed company, has to buy the Bt seed, non-Bt seed, and as a precaution, a pesticide also produced/recommended by the company!

Further, the Bt gene gets horizontally transferred to wild and related species. This can upset forest/natural ecosystem food chains by elimination of the [illegible] trophic level herbivorous insects, since the Bt toxin can kill non-target insects also (Ho Mae-Wan et al., The Ecologist, Vol. 28, 1998). Also while natural Bt toxin gets destroyed by UV rays of the sun, the toxin from decayed leaves of Bt crops persists in the soil, bound to clay and humus particles, and affects soil micro flora (Crecchio C. and G. Stotzky, Soil Biology and Biochemistry, Vol. 30, 1998).

In view of this it is truly surprising that the Department of Biotechnology [illegible], in its letter directing field trials of Bt cotton in Madhya Pradesh, states that studies on pollen flow and effects on soil micro flora are "not applicable [illegible]". It is, however, heartening to see that the Genetic Engineering Approval Committee (GEAC) has recently [illegible] permission for the commercialisation of Bt cotton in India.

"...not a single incidence of actual harm to human or animal health ...has yet been documented ... concerning [illegible] crops or health care products."

The random insertion of the transgene has been known to produce unpredictable disturbance in the host genetic function. Possible production of toxins and allergens poses potential health risks. The 1989 epidemic in the U.S. called Eosinophilia Myalgia Syndrome will forever remain a reminder (Mayeno A. N. and G. J. Gleich, Tibtech, Vol. 12, 1994). Consumption of a nutritional supplement, Tryptophan, derived from a bacterium, genetically engineered to overproduce it, had led to 37 deaths and 1500 permanently disabled consumers. There is also the well-known case of pest resistant GM potatoes containing the snow drop lectin gene, which when fed to rats inhibited growth, disrupted their immune system and produced viral infection symptoms (Ewen S. and A. Pusztai, The Lancet, Vol. 354, 1999).

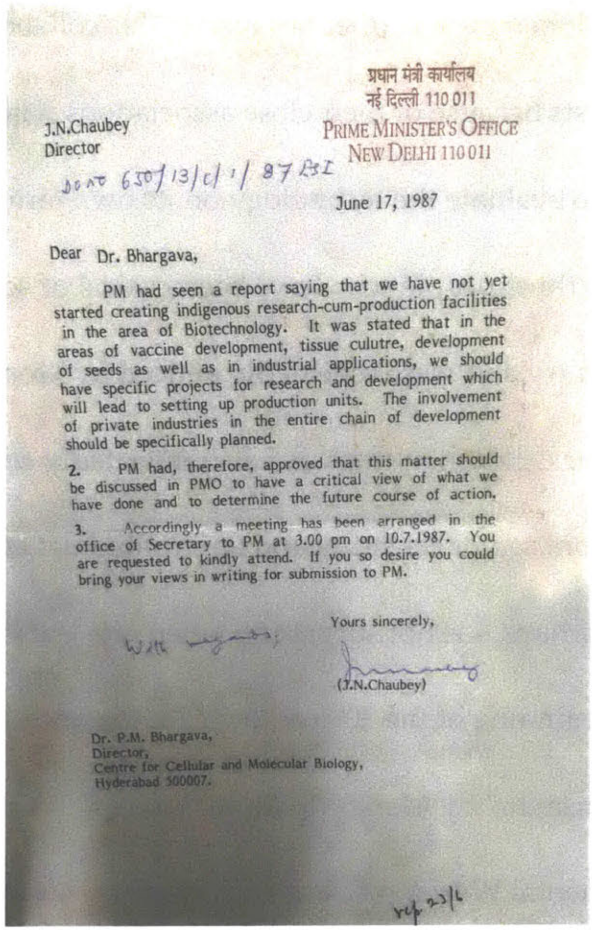
Unpredictability

Finally, I must draw the attention to the hugely important fact that recent breakthroughs in the science of Genomics undermine the concept of "genetic determinism", the very foundation of r-DNA technology. The spatial and temporal expression/activity of the same DNA sequence, placed within a new arrangement, could be quite different from the ones intended by genetic engineers. The unpredictability of behaviour of a gene in a new genomic environment has thereby multiplied several-fold.

The kind of evidence I have cited is being increasingly reported by scientists all over the world. Further, absence of evidence at a particular moment, of what is to be expected at any time, cannot allow us to become complacent. This is precisely why Europe has made labeling compulsory and banned many GM foods. And the U.S.-based Union of Concerned Scientists, including 100 Nobel laureates, is raising serious questions about r-DNA. It is to be hoped that the real spirit of Indian science will also assert itself over the sponsored research of company-based scientists.

• Dr. DEBASHIS BANERJI

The Hindu 10/7/01 - OPEN PAGE



प्रधान मंत्री कार्यालय
नई दिल्ली 110 011
PRIME MINISTER'S OFFICE
NEW DELHI 110 011

J.N.Chaubey
Director

DONo 650/13/c/1/87 BSI

June 17, 1987

Dear Dr. Bhargava,

PM had seen a report saying that we have not yet started creating indigenous research-cum-production facilities in the area of Biotechnology. It was stated that in the areas of vaccine development, tissue culutre, development of seeds as well as in industrial applications, we should have specific projects for research and development which will lead to setting up production units. The involvement of private industries in the entire chain of development should be specifically planned.

2. PM had, therefore, approved that this matter should be discussed in PMO to have a critical view of what we have done and to determine the future course of action.

3. Accordingly a meeting has been arranged in the office of Secretary to PM at 3.00 pm on 10.7.1987. You are requested to kindly attend. If you so desire you could bring your views in writing for submission to PM.

With regards,

Yours sincerely,

(J.N.Chaubey)

Dr. P.M. Bhargava,
Director,
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ref. 23/6

farmers over seed use, and producing the "terminator seeds" or seeds that produced plants with sterile seeds, inevitably questioned the credibility of Indian science and scientists. The lack of trust on political leadership for adopting neoliberal policies and opening the economy to multinationals, was transposed on to the state of Indian science and the lack of integrity of Indian scientists. Scientific research on agricultural biotechnology that was already moving at a decelerated pace throughout the 1980s, and 1990s with the perpetual problems of the lack of inter-disciplinary researchers in the field, the lack of infrastructure to carry on the research that would deliver biotechnological products at a larger scale, and the dearth of sufficient collaborations with industry, was questioned even further because of this collaboration. The conflict of interest of several scientists because of their close associations with Monsanto further eroded their credibility to evaluate the technology on its own terms. During my fieldwork, I encountered three people who have been critical of agricultural biotechnology in the country and were repeatedly enticed by Monsanto with money and offers to educate their children in the U.S. I also repeatedly encountered the phrase, "they are all sold out" from senior scientists and environmental activists about scientists in the DBT and ICAR. Perhaps it is not surprising when one leafs through the practices of Monsanto since the beginning of the 20th century. For instance, in the film "The World According to Monsanto" by Marie-Monique Robin, Ken Cook, president and co-founder of the Environmental Working Group, a non-profit, non-partisan U.S. organization, narrates how Monsanto secretively produced the carcinogenic PCB, and later colluded with the state authorities in Anniston, Alabama. The existence of the chemical factory in Anniston for over four decades led to serious environmental and human health issues because of exposure to PCBs.

The sale of *Bt* seeds escalated dramatically since then, from 72,000 packs in 2002 to 3 million in 2005 (Stone 2007). The primary reason stated by MMB for the introduction of *Bt* cotton was to resist American and pink bollworm. It did lead to higher yields in several regions of the country but the bollworms also became resistant to the protein in certain areas like Gujarat, leading to large-scale crop failure and losses. The wide spread farmer suicide and selling of kidneys in order to pay back the debts have been linked with the failure of *Bt* seeds by anti-biotechnology advocates like Vandana Shiva, Suman Sahai, and Aruna Rodriguez, although it has been argued that the claims of direct correlation between failure of *Bt* seeds and suicide are not supported by enough evidence (Herring: 2007)[12].

In spite of high costs of genetically modified seeds, a different regime of the use of pesticides, the lack of faith in the regulatory policies in India, a relevant question is, what are the reasons for a growing demand for *Bt* seeds in the initial years? Glenn Stone, in his essay, 'The Birth and Death of Traditional Knowledge: Paradoxical Effects of Biotechnology in India' (McManis: 2007) explains certain possible reasons through his ethnographic work carried on for four years in the state of Andhra Pradesh. A predominant explanation for the rapid spread of technology in agriculture has been the innovation-diffusion theory proposed by Ryan and Gross (1943), argues Stone. The crux of the theory is charting out stages in the adoption of new technology---- *initial knowledge* (farmer learns of innovation); *persuasion* (farmer forms attitude towards

[12] Vandana Shiva argues that one of the primary reasons behind farmer suicides was massive debts of the farmers which were impossible to return because in many parts of the country, Bt cotton did not necessarily lead to higher yields, thereby increasing the gap between costs incurred in cultivating Bt crops and the income received from their yields. This view is countered by Ronald Herring, who argues, the debts incurred by the farmers were not only because of cultivation of Bt crops but also due to other social events like marriage of their daughters, buying land etc. Hence, to establish a direct co relation between the debt crisis, failure of crops and farmers' suicide is too far fetched.

innovation); *implementation* (farmer adopts innovation); *confirmation* (farmer evaluates performance of innovation) (Stone 2007:209). This theory is clearly based on a positive connotation attached with 'innovation' and that sooner or later every farmer catches up with it. The innovation-diffusion theory has been extensively used by actors like MMB for the rising demand for transgenic seeds, on the ground that farmers are rational individuals, capable of making choices that suite best for them. However, Stone's engagement in the state of Andhra Pradesh revealed certain traits, which countered this overarching theory. First, he recognized that preference for certain seeds was a very local phenomenon--- a particular kind of seed largely adopted in one village was not necessarily adopted in the next one. Second, what was considered a favorite, changed rapidly. And third, a large number of farmers based their decision on "uncritical emulation" of what their neighbors adopted. Through his "ethnography of crazes", he explains the growing demand for transgenic seeds through the process of 'skilling' and 'deskilling'. Agricultural skilling, unlike in the factory which involves mechanical application of knowledge, is a dynamic process where the farmer is constantly adapting to new markets, technologies and social conditions. It also involves participation of farmers in each other's work and decision-making processes. However, what leads to a gradual 'deskilling' is the disruption caused by interventions like biotechnology which generates impediments to the skilling process in the form of "unrecognizability" (uncertainty about what technology is being used or before trials), "inconsistency" (high temporal, spatial and situational variability in performance) and "excessive rates of technological change" (Stone 2007: 212). Hence, biotechnology itself promotes skilling, but it also brings along these three impediments, leading to massive deskilling. The justification for the escalating demand is, therefore, not adoption or adaptation to the new technology, as much as a perennial craze among the farmers with an undying hope for higher yield.

Within the first few years of the commercialization of *Bt* cotton, newspaper reports and articles started surfacing that brought out both the advantages and disadvantages of using *Bt* cotton in the country. Most of the writings in favor of GM seeds highlighted the significant increase in the yields of cotton as a result of the decreasing attacks by pests like American and pink bollworms. The voices against the cultivation of GM seeds have been high prices of the seed packets and the connections with large scale farmers' suicides, the issue of corporate control of agriculture, the resistance developed by pests over the years, and the problem of monocropping. One problematic direction of these writings promoting or opposing gm seeds, was the fact that proponents came to be considered as "scientific" whereas opponents were often regarded as "political". Simultaneously, "opponents are accused of being anti-science or Luddite in their approach to technology; proponents are accused of being duped by 'science' produced for corporate interest backed by corporate money." (Herring 2014: 207). It is important to remember (as I describe in the next few paragraphs) that there are scientists who have supported as well as opposed agricultural biotechnology in the country, as well as, farmers' organizations and civil society groups that been on both sides of the debate. However, what emerged as conspicuous in these debates during the first few years of the use of *Bt* cotton, was the discourse on risk around the environment and human health. Conceptions of risk became the fulcrum around which opinions both for and against the technology came to be anchored. Risk had never been discussed and debated at this scale around agriculture in the country before this. The need for a central authority to handle all biotechnological interventions was first conceived in 2003-04 when a task force headed by Dr MS Swaminathan proposed a National Biotechnology Regulatory Authority in their report (NBRA). The revised version, the Biotechnology Regulatory Authority of India Bill (BRAI), was tabled in the Lok Sabha (the Lower House of the Parliament) on 23rd April 2013, after almost a decade of the submission of NBRA, in the face of rising protests from several quarters inside as well as outside the parliament. The most significant characteristic of the BRAI bill was its attempt to centralize the control of any activity associated with GM organisms in India. In case of genetically modified crops, the proposed bill consolidated the responsibility of RCGM, GEAC and the entire regulatory system through the Biotechnology Authority. It was not taken forward because it still did not demand any accountability from the sides of the Indian companies in case of crop failure and most important, the conception of risk did not take the larger environmental, social, and economic conditions that have always played a significant role in determining the outcome in agriculture, especially in cultivating GM crops.

Bt Brinjal: Dissent, Democracy, and Science

In this climate of doubt and large scale protests, there were simultaneous efforts by the central government to legalize *Bt* brinjal. *Bt* brinjal was developed by Mahyco in collaboration with University of Agricultural Sciences and Tamil Nadu Agricultural University. An expert committee, EC I, was set up by GEAC in 2006 to assess the environmental risks of cultivating *Bt* brinjal. Although the EC I concluded that *Bt* brinjal was as safe as its non *Bt* counterpart, it proposed that more large scale trials needed to be conducted to be certain about the benefits of pest resistance of *Bt* brinjal compared to the present pest management practices that were already existing. In 2009, another Expert Committee, EC II was set up that ultimately cleared the commercial cultivation of *Bt* brinjal in the country, although there were scientists including Prof. Bhargava, the Supreme Court appointee in EC II, who pointed out the insufficiency of data produced by Mahyco and several internal inconsistencies within the EC II report, the committee overlooked these concerns and cleared *Bt* brinjal anyway. During one of the interviews with Prof. Bhargava, he pointed out that the committee submitted the report to GEAC on 9th October and by 14th October, GEAC cleared *Bt* brinjal for cultivation.

In January 2010, in response to protests from environmental and farming communities and civil society groups, the then environmental minister, Jayaram Ramesh, organized public hearings in cities across the country that were attended by farmers' organizations and independent farmers, environmental activists, scientists, civil society groups, representatives from Mahyco, and members of the state governments. That was the first time that a member of the parliament made an attempt to provide an official platform for different communities to present their opinions about GM food crops in the country. Several independent scientists from across the world expressed their opinion on the topic. Nearly 6000 people registered for these meetings across seven cities with a few thousand more participating or doing demonstrations outside the meeting venues. More than 9000 written submissions were presented to the Minister and he sat through 25 hours of "heated consultations".[13] There were voices both for and against the technology. Some of the reasons that were brought forward against the commercial introduction of GM in food crops were the inadequacy of data on environmental risks and the fact that Mahyco produced its own data without any independent agency doing the fact checking, the conflict of interest due to the involvement of GEAC members with seed companies, the increasing role of multinationals in controlling agriculture, the lack

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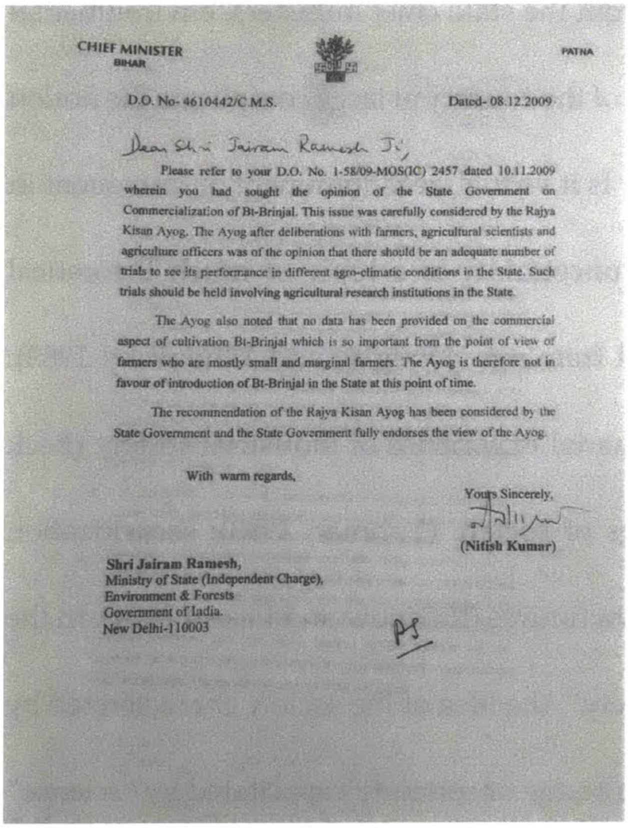
[13] For more on the details of the consultations, please read "National Consultations of Bt Brinjal" Report Prepared by the Centre for Environment Education (CEE) for Ministry of Environment and Forests (MoEF), Government of India, 10th February, 2010

of system of labeling in the food industry, the inadequacy of data as far as toxicity, India being the center of origin/diversity of brinjal, cross pollination and other factors around human health and the environment. The lack of transparency on the part of the government in bringing *Bt* cotton to India and later clearing the legal cultivation of GM eggplant remained at the root of most of the voices against GM crops. The letters and voices brought out questions about the relation between science and democracy in India, the credibility of science and its relationship with society. An independent writer, Sreedevi Lakshmi Kutty, sent a long letter to Ramesh, critiquing the basis on which the EC II cleared the commercial cultivation of *Bt* brinjal. She presents an excerpt from the article "New Agricultural Biotechnologies: the Struggle for Democratic Choice" by Middendorf et al: "A key principle of these efforts is that society must democratically define its priorities, only then should it ask how technologies might help to achieve those goals. This challenges the common assumption in science policy of a positive, linear relationship between scientific advance and social progress. Another guiding principle since all citizens experience the effects of science and technology, and citizens ordinarily expect to have a voice in decisions that will affect the way they live their daily lives, they should be involved in deciding the direction of science and technology policy." Aruna Rodrigues, a well known anti- Gm activist in the country wrote about loopholes in the risk-assessment around *Bt* brinjal in her critique of the EC II decisions: " The methods of rigorous bio-safety risk-assessment in their time-scale are by definition, long-term, to uncover the potential harmful changes in GE proteins in foods a s a result of the transformation process. These include testing procedures for chronic toxicity. Yet, the EC II Report and Regulators are on record dismissiong both, scientific methods of risk assessment and long term multi-generational animal feeding studies because they will take too long. The question must be asked: too long for whom? The reasons that underlie the need to first, safety test GMOs and second, define the methods to be employed in their rigorous testing, form the very core of how this technology is to be addressed and regulated. "Unintended effects" are inherent to the process of genetic engineering." She further writes: " We have the Regulators' astonishing *raison detre* for the commercialization of *Bt* Brinjal: It is based on the a) proven safety of the *Bt* gene; and b) higher intrinsic yields and performance yields because of its efficacy against the bollworm pest and no resistance developing. These are claims that do not stand the scrutiny of science or the experience on the ground by our farmers. India is unlikely to buck the trend in other countries because simply because the Regulators and Monsanto demand it!" Prof. Bhargava pointed out specific tests that should be conducted before the environmental release of GM crops.

Chief ministers of several states in India including Kerala, Maharashtra, Andhra Pradesh, Bihar, West Bengal conducted research with their own states with the help of research institutes and opposed the cultivation of GM brinjal. The main concerns were around biosafety issues and the difficulty for farmers because of high input costs.



CHIEF MINISTER
BIHAR

PATNA

D.O. No- 4610442/C.M.S. Dated- 08.12.2009

Dear Shri Jairam Ramesh Ji,

Please refer to your D.O. No. 1-58/09-MOS(IC) 2457 dated 10.11.2009 wherein you had sought the opinion of the State Government on Commercialization of Bt-Brinjal. This issue was carefully considered by the Rajya Kisan Ayog. The Ayog after deliberations with farmers, agricultural scientists and agriculture officers was of the opinion that there should be an adequate number of trials to see its performance in different agro-climatic conditions in the State. Such trials should be held involving agricultural research institutions in the State.

The Ayog also noted that no data has been provided on the commercial aspect of cultivation Bt-Brinjal which is so important from the point of view of farmers who are mostly small and marginal farmers. The Ayog is therefore not in favour of introduction of Bt-Brinjal in the State at this point of time.

The recommendation of the Rajya Kisan Ayog has been considered by the State Government and the State Government fully endorses the view of the Ayog.

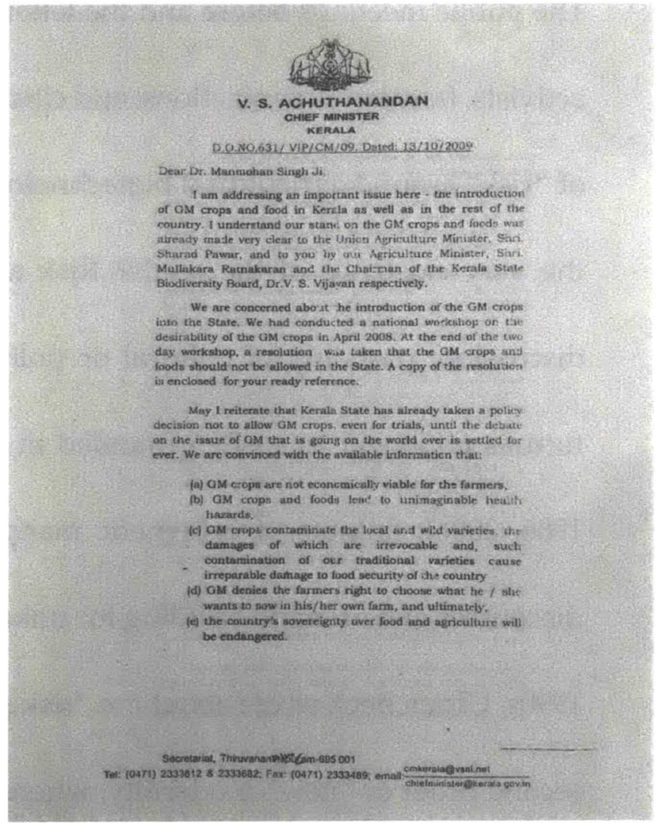
With warm regards,

Yours Sincerely,

(Nitish Kumar)

Shri Jairam Ramesh,
Ministry of State (Independent Charge),
Environment & Forests
Government of India.
New Delhi-110003

PS



V. S. ACHUTHANANDAN
CHIEF MINISTER
KERALA

D.O.NO.631/ VIP/CM/09. Dated: 13/10/2009

Dear Dr. Manmohan Singh Ji,

I am addressing an important issue here - the introduction of GM crops and food in Kerala as well as in the rest of the country. I understand our stand on the GM crops and foods was already made very clear to the Union Agriculture Minister, Shri. Sharad Pawar, and to you by our Agriculture Minister, Shri. Mullakara Ratnakaran and the Chairman of the Kerala State Biodiversity Board, Dr.V. S. Vijayan respectively.

We are concerned about the introduction of the GM crops into the State. We had conducted a national workshop on the desirability of the GM crops in April 2008. At the end of the two day workshop, a resolution was taken that the GM crops and foods should not be allowed in the State. A copy of the resolution is enclosed for your ready reference.

May I reiterate that Kerala State has already taken a policy decision not to allow GM crops, even for trials, until the debate on the issue of GM that is going on the world over is settled for ever. We are convinced with the available information that:

(a) GM crops are not economically viable for the farmers,
(b) GM crops and foods lead to unimaginable health hazards,
(c) GM crops contaminate the local and wild varieties, the damages of which are irrevocable and, such contamination of our traditional varieties cause irreparable damage to food security of the country
(d) GM denies the farmers right to choose what he / she wants to sow in his/her own farm, and ultimately,
(e) the country's sovereignty over food and agriculture will be endangered.

Secretariat, Thiruvananthapuram-695 001
Tel: (0471) 2333812 & 2333682; Fax: (0471) 2333489; email: cmkerala@vsnl.net
chiefminister@kerala.gov.in

There were voices in favor of the introduction of *Bt* brinjal from seed companies and a few farmers' organizations. The main reason for their stand were the possibility of higher yields and pest resistance. In an interesting letter by P. Chengal Reddy, Secretary General, Consortium of Indian farmers Association (CIFA), he writes that there is shortage of labor in agriculture and the use of biotechnological tools could address that problem, although the point is not explained any further. Due to the overwhelming presence of voices against the introduction of BT brinjal, Ramesh finally placed a ten-year moratorium on the commercial cultivation of Bt brinjal in the country for ten years.

The public meetings before and the letters from the state chief ministers, environmental activists, farmers' organizations, and citizens of the country at large complicate the notion of "risk" around agricultural biotechnology. Is it virtual, real, imminent or immanent in the very existence of the seeds? Risk and uncertainty is a topic of much theoretical discussion: partiality of cultural or political framings (Douglas and Wildavsky 1983); futures no longer as easily grounded in actuarial experience of industrial society (Beck 1986, 2006); failures of cybernetic mappings of society (Luhman 1993); securitization discourses and scenario building for unknown futures (Rabinow and Lakoff 2004). In the 1990s, Ulrich Beck wrote about the "risk society", the idea of the society characterized by second order or "new" modernity, where the badge of certainty capacitated by "science" and rationality is continually getting replaced by an "awareness of threat", which is reflexive, uncertain, and capillary. In fact, science and technology is becoming the breeder of several risks in the present through what Beck terms as "primary" to "secondary" scientization (Douglas and Wildavsky 1983; Castell 1991; Giddens 1990, 1991; Douglas 1992; Irwin 1995).

In 'Risk Society: Towards a New Modernity', Ulrich Beck describes Risk Society as 'an inescapable *structural* condition of advanced industrialization' (Beck 2006: 333), where some notion of risk, albeit virtual, is omnipresent in societies. These new kinds of risks in modern societies, Beck argues, are distinct and different from earlier notions of risks because of 'global anticipation of global catastrophes' (Beck 2006: 333). The theory of global risk society identifies three characteristics of risks: "delocalization" (where causes and consequences are not limited to a specific bounded locality), "incalculableness" (these risks, in principle, cannot be calculated. They are based on 'science induces not-knowing and normative dissent) and "non-compensability" (the logic of compensation is replaced by 'precaution through prevention') (Beck 1986). He further argues this inherent notion of 'unknown unknowns', makes risk itself a political and an ethical issue because the definitions and consequences of risks in risk societies are inevitably decided by those who have the power to define 'what' is risky and for 'whom'. At the individual level, the experiences of risks leads to 'tragic individualization', where the state apparatuses or scientific establishments are inadequate in handling risks, leaving it to the judgment of individual citizens without laying out the causes or consequences of risks. As Beck points out: "...responsibility for the decisions on genetically modified foods and their unforeseeable, unknowable long-term consequences is ultimately dumped on the so-called 'responsible consumer'. The appeal to 'responsibility' is the cynicism with which the institutions whitewash their own failure" (Beck 2006: 336). Another characteristic of the risk society is the indispensability of recognizing connectedness at a scale that theoretically transcends national, geopolitical boundaries: "In view of universality and supra-nationality of the circulation of pollutants, the life of a blade of grass in the Bavarian forest ultimately comes to depend on the making and keeping of international agreements. Risk society in this sense is a world risk society" (Beck 1992: 23), and paradoxically so because it constitutes and gets constituted by those very hierarchies that its analysis attempts to transcend. Several works on environmental studies, especially environmental health, have problematized the idea of risk as uncertainty that can be "measured" (Irwin 1995, Fortun 2001, Corburn 2005, Auyero and Alejandra Swistun 2009, Nash 2006, Petryna 2002, Biehl 2007, Tsing 2006). These scholars have written about the need for inclusion of experiences and subjectivities of the people suffering from environmental threats into the formation of risk rather than relying on statistical cost-benefit analyses that give a false sense of rationality and control.

The line between risk and catastrophe, in this case, gets blurred, leaving the category of risk either inadequate or fluid. Beck distinguishes between risk and catastrophe on the basis that the former is the imagination of catastrophes whereas the latter is the realization of risks. If this is a distinction that he maintains is characteristic of global risk societies, it places India in a liminal position of sorts, complicating risk itself in this case. In India, *Bt* seeds have been planted in several regions with or without permission from

GEAC; the yields have been higher in certain cases whereas there has been manifold destruction of crops in certain other areas, almost amounting to a catastrophe; regulatory authorities have constantly faced charges of being severely inadequate. Hence, the present situation in India is either beyond or before risk ('beyond' because the issues here are too real to be considered as risky; 'before', if one uses Beck's notion of modern societies which overcome catastrophe by creating the specter of risk, which is always necessarily virtual). This accounts for the wide spread protest against introducing GM technology in food crops in India, unlike the internalization of normalcy of using transgenic foods in America.

Pushing the idea of risk a little further, one can ask, why is it so important to analyze the unintended consequences of GM crops? Is this concern or fear somehow rooted in a commitment to the purity of nature in agri-culture? Are there, flowing in between the texts of controversies around genetically engineered foods, "unintended tones of fear of the alien and suspicion of the mixed?" (Haraway 1997: 61). Is, really, "what is at stake (is) this culture's stories of human place in nature, that is, genesis and its endless repetition" (Haraway 1997:60)? From an anthropological perspective, the question of risk around genetically engineered foods can be understood as embedded in the polemic of the nature-culture binary. If splicing of genes from unrelated organisms lays at the root of the possibility of unintended consequences and therefore risks, the idea of a "mix" or "hybrid" can be used to substantiate or counter the nature/culture boundary. In the context of bioengineered foods, this binary is often evoked with overtly political goals. As Sheila Jasanoff notes, the Biotechnology Industry Association (BIO)—an association lobbying for the agricultural and pharmaceutical sectors, "lists the first three achievements of biotechnology as the brewing of beer by Sumerians in 1750 B.C, the use of moldy soybean curds as an antibiotic by the Chinese in 500 B.C … the march of biotechnology at 8000 B.C, with the first domestication of crops and livestock" (Jasanoff 2005: 96). The anthropological impossibility of getting back to the origin stories of pristine, pure nature, can be used as an explanation for making no distinction between brewing beer in 1750 B.C and gene splicing. At the same time, discourses on organic farming in India constantly evoke this very idea of forced hybridity as problematic and polluting to the ecology at large.

Explaining this very dilemma associated with the concept of risk embedded within the nature-culture binary is Paul Rabinow's notion of "biosociality" (Rabinow: 2008). Approaching the human genome project through three levels—the initiative itself; the institutions and enterprises, like the biotechnology industry, through which concepts of life and labor are articulated; and the framework of bioethics and environmental ethics—Rabinow articulates "biosociality" as "nature molded as culture understood as practice. Nature will be known and remade through technique and will finally become artificial, just as culture becomes natural. Were such a project to be brought to fruition, it would stand as the basis for overcoming the nature/culture split' (Rabinow 2008: 241). In the context of genetic engineering, he writes: "The term manipulation carries with it the appropriate ambiguities implying both an urge to dominate and discipline as well as an imperative to improve on the organic. Confronting this complexity constitutes the challenge of artificiality and enlightenment" (Rabinow 2008:250). The concept of risk or unintended consequences lies at the heart of this ambiguity. The FDA's rationalist claims, highlighting the promise of genetic engineering, as well as the perennial fear of the unknown reside simultaneously in engineered seeds. And the challenge is in its very simultaneity---- the normalization through a constant disembodiment of risk from its object, that is the crops or engineered foods, running parallel to the glory of controlling 'nature' by bringing exact traits in the engineered organisms--- presenting a perfect example of an imperfect rationality.

In India, on the other hand, the challenge is to identify and ameliorate the material conditions of agriculture and policy making in order to reach a position to either adopt or discard biotechnology in food crops. Glenn Stone's distinction between "field studies" and "farm studies" explains two different approaches of understanding the situation of GM seeds in India and presents possibilities of evaluating risk following the same model (Stone: 2011). Charting out the technological changes in cotton cultivation, he considers field studies as 'usage, concern crop performance under growing conditions, key variables being input, ecological phenomenon, yields and profits. Farm, here refers to a socio economic management unit with such parameters as debt and income, access to labor and land and technology, social linkages with other farm and vendors and indigenous knowledge' (Stone 2011:388). He argues for the importance of a farm level view when assessing the impact of Bt cotton to understand broader relations instead of looking at only the yield. Similarly, in order to understand the notion of risk, one has to investigate the parallel, coeval and conflicting processes around plant biotechnology in India and the possibilities of risk that these conditions pose for the future.

The adoption or repudiation of GM crops, like I have already mentioned before, vary from one country to another but even if they are adopted, there are always different justifications for doing the same. In the U.S., the influx of bioengineered foods is based on their potential of achieving certain desired results like longer shelf life, resistant to pests and the like . In India, on the other hand, the introduction of GM seeds fits well within the need for science and technology in agriculture; the rhetoric of higher yield following the green revolution; and the specific needs of biotechnology in a developing country (for instance, in the absence of adequate preservation options, the need for biotechnology to control rotting in warm, humid weather conditions)---- placing plant biotechnology within a 'politics of anxiety and desire in India' (Visvanathan and Parmar:2002). Both the proponents and opponents of biotechnology in India evoke

'Science' rhetorically---- the proponents highlight the intentional control of insects and higher yields whereas the opponents focus on the loss of biodiversity and adverse ecological impacts of *Bt* seeds. However, as Mark Pearson points out, using 'science' through the global environmental management discourse of Monsanto, as well as by the anti biotechnology NGOs, are both highly problematic because they try to govern the farmers through a convenient interpretation of science in the Foucauldian sense of governmentality (Pearson: 2002). And the idea of imminent risk runs through these discursive turns against biotechnology.

In the U.S., the notion of risk has transformed, been disembodied from the object of GM crops, and diversified over time. In India, the conglomerated category of risk, uncertainty and threat is paradoxically a common feature in agriculture. However, during the biotechnology era, the concept of risk in India has been interlaced within the discursive paths taken by anti biotechnology campaigns, without ever having a concrete description of what risk is and without the farmers themselves identifying this thing called 'risk' in their lives. Further, however risk has been used, it has been intrinsically linked with larger social, political and economic realties like the role of the state, political economy of the crops, erosion of biodiversity etcetera. This situation, in a way, challenges the notion of the risk society propounded by Ulrich Beck (Beck: 1992) because knowledge about risks, which is a fundamental component of a risk society, is completely fissured. The farmers, who seem to be a 'class in itself', are yet to conceive of environmental or health risks as all pervasive forces. However differently the concept of risk manifests itself in both the countries, it destabilizes as well as reinforces the security and linearity of modernity and rationality. The challenge is therefore to construct another paradigm of conceptualizing plant biotechnology, which contains risks and unintended consequences within its very being and becoming.

The establishment of the DBT to the decision to release *Bt* cotton in the market to the moratorium placed on *Bt* brinjal is anything but a story of nation and science as stable categories with pre-determined goals and intensions. Not only did agricultural biotechnology open an unprecedented chapter of questioning how science or democracy is or should be done, the actions of individuals like CR Bhatia and Jairam Ramesh make it explicit how fractured concepts of the nation are and the possibilities of collaboration across different groups that are present. Bhatia's personal connections with Mahyco led to a historic event of its collaboration with Monsanto. Similarly, although the MoEFCC had cleared the commercial cultivation of GM brinjal, Ramesh's attempts forged unexpected relations between scientists, farmers' organizations, environmental organizations and indeed fortified the discussion on environmental risk at the fulcrum of the GM debate. The against the introduction of GM seeds, linked agriculture and the environment in unique ways as well as, brought scientific practices and policy under the public gaze and critique at the national scale for the first time. The discussions about the lack of studies on risk and biosafety of consuming GM food, especially about culturally specific crops like brinjal, evoked both science and culture that ultimately aimed for a more interdependent and ecological relation between agriculture, environment, and human health. Further, as Ashish Nandy points out in *Science as a Reason for State*, "scientists often become the ultimate sources of legitimacy for the Indian state… although it does not matter whether the technology is innovative or replicative, moral or immoral, obsolete or new. For technology, comes to represent an escape from the dirtiness of politics, it becomes an indicator of brahmanic purity." (Nandy 1989: 4). The debates around agricultural biotechnology indeed unsettled this notion of supremacy of science and scientists and connected the otherwise less-discussed field of agriculture with science policies at the national scale by bringing critique and dissent at the heart of both democracy and science.

Epilogue

"The only way to an accurate view and confident knowledge of the world is through a sophisticated epistemology that takes full account of intractable contradiction, paradox, irony, and uncertainty in the explanation of human activities. This seems to be the spirit of developing responses across disciplines to what we described as a contemporary crisis of representation."

George Marcus and Michael Fischer

Anthropology as a Cultural Critique

1999: 15

"Wherever I go in and around Durgadaitya, I am asked where am I from. When I reply, Kolkata, I am further asked that's fine, but where are you actually from, which village? When I reply that I have only lived in Kolkata all my life and then in Delhi, they ask me, that is fine, but where are your ancestors from? Which village? Varsha didi introduces me to everybody as "she lives on the other side of the river Ganga and she studies in America."

Along with all these new forms of agriculture--- and a changing concept of the land, really--- the different, new kinds of seeds, pesticides, new pests, there is simultaneously, a deep sense of the place. I am finding it difficult to articulate this "presence of many" or seemingly contradictory situations. It is not tradition and modernity, or the Parsonian systems theory, or I cannot only explain this through the Geertzian "meaning". It is something more and I don't know how to explain it. Braiding? Juxtaposition? I'll keep thinking"

--- Field notes 17th Novemner 2016

I have used this contradiction as a method in doing, thinking, and writing this dissertation. The introduction of agricultural biotechnology has led to significant changes in the everyday lives in the agrarian space. Like I have described in the dissertation, the unprecedented number of *Bt* cotton seeds in the market, the infestation by new pests, the need to consult the seed sellers regularly, environmental contingencies, cotton price fluctuations have successively made practicing agriculture complex. One needs to make more decisions than before, about when to sow the seeds, when to spray pesticides, on a regular basis around the cultivation of GM seeds. As a result, the relation between land and humans, and the conceptions of one's own plot of land is slowly changing. One striking way in which several people explained this changing conception of the land was by using the phrase, *"santulan kho gaya hai"* or "the equilibrium is getting lost" these days. These experiences and imaginations of change and movements can be explained through what George Marcus and Michael Fischer describe as "the crisis of representation". The clear boundaries between tradition and modernity, for instance, cannot hold these changes that brought about by a new regime of agriculture.

Whether it is the sites of my fieldwork, the themes, and the lives that I write about, or the literature that I engage with, I have found it challenging to hold together simultaneous, different, often contradictory situations and events. The dissertation has been a constant struggle to find a way to articulate ideas that do not necessarily co-exist with each other. Every chapter, in a way, has been an attempt to articulate the contradiction whether it is the analysis of the ways in which the materiality of the *Bt* seeds entwine with the practices of the breeders, the co-existence of different forms of labor, or the juxtaposition of scholarship on farm labor alongside questions of biocapital.

Simultaneously, during my stay in Durgadaitya, I came across a deep sense of the place, where people's lives, stories, and futures are strewn around the village that they come from and for women, where they get married to. During several conversations that I had with Anil *bhaiya* and Varsha *didi* about how marriages are fixed, within the broader framework of hypergamy, one always inquiries about the "village" from where the bride or the groom is chosen. Most importantly, people study the history of "len-den" (give and take) of women from a specific village. The villages are organized around caste and sub-caste, so families looking for brides and grooms know which are the villages that make the broadest pool from where to select a person. Within that range, people usually know, through their own experiences of exchange of women or through larger networks of kinship, the characteristics if the villages--- whether the village is overall peaceful or people engage in fights often, what kinds of villages are women coming from and where are the women from there moving to, whether people have any history of marrying more than once. When families look for brides and grooms, they usually have a "parichay-patra" or biodata where the name of the village, caste, sub-caste, village of the woman/man's mother/maternal uncle are important information that are mentioned. As Anil *bhaiya* pointed out, "sometimes we like the boy but not the village, or we end up liking the village but not the boy. Either way, we cannot carry forward with a match unless we like both". Although young people are out-migrating in larger numbers for either education or job than the earlier generations, the sense of the place as a way to imagine belonging as well as in making practical decisions like formalizing marriages, exist alongside the changing practices of agriculture, which is the primary way of life and livelihood in the village. It is this simultaneous presence of change, movement in land and agriculture on the one hand and the constant, more stable notion of the village that has been difficult to write about. At the same time, I have used this experience of the presence of simultaneous, often contradictory ideas to guide the writing of the rest of my dissertation.

Another challenge that I have faced is to think and write about the different kinds of "fields"--- literally, metaphorically, and anthropologically. The place of the field and fieldwork as that which fortifies the discipline of anthropology has been written about in the recent past. Simultaneously, there are writings on how the form of the field as well as fieldwork have been changing in the past two decades. As Akhil Gupta and James Ferguson write in "Anthropological Locations", there is still an idea of "real fieldwork" and "real fieldworker" when the field is distinctively different and far-away from "home". And, by home, they imply the social and economic conditions that are present in Europe and North America. For me, therefore, to do fieldwork in a remote village and a cutting edge seed company, and to write about them, not in a comparative way but in a way where there are overlapping, inter-connected themes, has been challenging. For one, the literal "field" of the farming communities in Vidarbha and the "field" at NSL were embedded in very different history, political economy, and practice. The field of a farmer is a means of livelihood and identity whereas the research field of the companies are more like experimental zones where contingencies play out very differently than in villages. Not only were the fields different, the kind of fieldwork that I conducted were different, and the knowledge, relations, and the analytic frameworks were often contrasting in these two sites.

And, finally, to thread the dissertation around the materiality of the seeds and the practices of the communities, and the simultaneous engagement with anthropological as well as STS literature has been very interesting but sometimes difficult. To write about labor conditions and the mode of production debate, alongside thinking about GM seeds as "actants" or "vibrant materialities", clearly emerges from my training in HASTS. In the dissertation I have juxtaposed some of these theoretical frameworks and genealogies of ideas, within the overarching association between materiality, practice, and time. For the book manuscript, I hope to create a *dialogue* between these contrasting fields of practice and ideas.

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