Summer 8-15-2016

Cultivating Knowledge: The Production and Adaptation of Knowledge on Organic and GM Cotton Farms in Telangana, India

Andrew Flachs
Washington University in St. Louis

WASHINGTON UNIVERSITY IN ST. LOUIS

Department of Anthropology

Dissertation Examination Committee:

Glenn Davis Stone, Chair
Peter Benson
Geoff Childs
Gayle Fritz
Gautam N. Yadama

Cultivating Knowledge: The Production and Adaptation of Knowledge on Organic and GM Cotton Farms in Telangana, India

by

Andrew Flachs

A dissertation presented to the
Graduate School of Arts and Sciences
of Washington University in
partial fulfillment of the
requirements for the degree
of Doctor of Philosophy

August, 2016

St. Louis, Missouri

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

ANGRAU	Archarya NG Ranga Agricultural University
BC	Backward Caste
Bt	Bacillus thuringiensis
MATCH	(Psuedonym) NGO representing non-GM cotton farmers
SUS	(Pseudonym) Umbrella NGO for Sustainable Agriculture
PANTA	(Pseudonym) NGO Representing non-certified organic farmers
DBT	Department of Biotechnology
ICAR	Indian Council of Agricultural Research
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IPM	Integrated Pest Management
GEAC	Genetic Engineering Approval Committee
GIS	Geographic Information System
GMO	Genetically Modified Organism
GM	Genetically Modified
GPS	Geographic Positioning System
NGO	Non-Governmental Organization
NPM	Non-Pesticide Management
MNC	Multinational Company
OC	Open Caste
OPV	Open Pollinated Variety
RDF	Rural Development Foundation
SC	Scheduled Caste
SHG	Self Help Group
SRI	System of Rice Intensification
ST	Scheduled Tribe
US	United States
USDA	United States Department of Agriculture

Acknowledgements

Many people and institutions contributed to this dissertation. It is both humbling and extremely gratifying to give them their due praise in this section: humbling because, despite the individualist nature of sociocultural anthropology and dissertation-writing, I owe my intellectual development, my work, my funding, my skillset, and my very sanity to a dedicated group of friends and colleagues; gratifying because I am allowed to break the individualist plane for a moment and recognize their contributions.

Within India, I am grateful to the many farmers, scientists, academics, and officials who allowed me to speak with them. These people are too numerous to mention, but a few deserve special recognition. Dr. E. Revathi of the Centre for Economic and Social Studies and Dr. R. Ganesan provided valuable logistical support, intellectual advice, and helped arrange my Indian research visa. Ramavath Bikshapathi and Golusula Rani provided support and friendship as I worked in their villages and beyond. Dr. Uma Reddy helped connect me with important agricultural data, farmer societies, and alternative farming models. The staff of Prakruti Organic and the Centre for Sustainable Agriculture were gracious enough to host me and help in this research, particularly Kishan Rao. Without the support of Ram Mohan Rao and Vandita Rao, I would never have been able to conduct this research. They provided contacts, logistical support, a network of tireless friends, teachers, and students through the Rural Development Foundation, and allowed me to feel truly welcome and at home at Kavrupad. I am especially grateful to Ram Mohan for innumerable book suggestions, terrific conversations on India, religion, and history, and his insightful perspective on India. Even at my most critical and analytical, I truly believe that their goodwill and tremendous efforts in developing and empowering rural India through RDF are changing Telangana, India, and the world for the better.

As a foreigner who arrived in Telangana in 2012 speaking only the most basic Telugu, I am indebted to the assistance and friendship of my research assistants: Christine Diepenbrock, Golusula Rani, G. Ranjith Kumar, Arun Vainala Kumar, Shivaprasad Citimar Sonnar, Koduri Karthik, Mutiraj Vykuntam, Jadav Chakradhar, and Barik Rao. Each taught me a great deal about India, provided excellent insights into this research, and was willing to work with me in the often hot, wet, and unpleasant rural conditions that this research required. I am especially grateful to Ranjith and Arun, who invited me into their homes, who helped to arrange further research assistants, and who went above and beyond in their service to this project. It would not have been nearly as fun without them.

My work was made possible with the support of Washington University in St. Louis and the Department of Anthropology. My dissertation research itself was funded in part by the Jacob K. Javits Fellowship, the National Geographic Young Explorer's Grant, the William L. Brown Center at the Missouri Botanical Gardens, the Lynne Cooper Harvey Fellowship, and the John Templeton Foundation (Glenn Stone, PI).

It would be impossible to catalog the ways in which my advisor, Glenn Stone, has shaped this project and molded my academic trajectory. He suggested that I work in India; he introduced me to the intellectual framework of political ecology; he, unsuccessfully, has tried to stop me from writing in triplets. The theories presented in this dissertation are not just heavily informed by

Glenn's writing and suggestions. In many cases, they stem from the hours-long conversations in Glenn's office where he helped me articulate what I was thinking in the first place. From the first year that we met, Glenn involved me in his research and his publications, listening and engaging with my thoughts on everything from social theory to the Dead. There are probably many brilliant, patient, and supportive academic advisors. However, I believe it is rarer to find someone who is also capable of precisely diagnosing argumentation. Glenn has a rare gift in constructing stories – it's what makes him such an effective advisor, editor, intellectual coach, and scholar. He is able to help you discover the perfect phrasing and the right theory, or in my case, to help you cut away extraneous remarks in favor of that which is truly important. I fear that this dissertation likely still has "too many notes" as he once told me, but I am grateful to have the kind of mentor willing to listen and take them seriously anyway.

At Washington University, I have been fortunate enough to have an extremely supportive dissertation committee. Geoff Childs and Peter Benson commented on numerous early drafts of this research. Geoff in particular helped me to develop my integration of quantitative and qualitative data and survey design while Peter introduced me to helpful philosophers of knowledge and capitalism and has encouraged me to develop a richer ethnographic voice. I am extremely grateful to Gayle Fritz for introducing me to the field of ethnobotany, for introducing me to the people and resources of the Missouri Botanical Garden, and for enabling me to better examine the role of botany and deep history in my work. I am grateful to Gautam Yadama for his willingness to serve on this committee and to provide helpful perspectives on South Asia and development from outside my own narrow disciplinary lens.

Without the administrative or emotional support of Elaine Beffa, Amanda Heitkoetter, Kathleen Cook, or Kirsten Jacobsen, I am sure that I would never have made it through this program. I am grateful to Cindy Traub, Jennifer Moore, and Mollie Webb, who were incredibly patient in helping me manage this unwieldy dataset and analyze it using quantitative software. Jan Salick and Rainer Bussmann helped me develop my ethnobotanical inquiries, helped train me as a plant collector, and provided both funding and helpful contacts in India. Lastly, I am indebted to Talia Dan-Cohen, Kedron Thomas, John Bowen, and Iver Bernstein for their comments on parts of this dissertation and to their help in encouraging my exploration of science and technology studies, the fashion industry, and the history of global agrocapitalism.

My friends and colleagues at Washington University encouraged me to explore new angles in my work, commented on drafts, helped me analyze my data, and, most importantly, listened to my frustrations and celebrated my breakthroughs. James Babbitt, Carolyn Barnes, Andrea Bolivar, Elissa Bullion, Anita Chary, Steven Goldstein, Ashley Glenn, Robbie Hart, Alison Heller, Ed Henry, Brad Jones, Josh Marshack, Natalie Mueller, Kelsey Nordine, Joseph Orkin, Efstathia Robakis, Elyse Singer, Christopher Shaffer, Maggie Spivey and John Willman, I am grateful to have such intelligent and supportive friends as you. Outside academia, I am grateful to HTYB and Rhonda Smythe for their help in balancing work and life. My mother, father, and sister helped inspire my love of learning, travel, and the outdoors. They, in short, made me an anthropologist. And most importantly to Iris, who has inspired me to pursue this dream and given me a lifeline home more times than she knows. I am so grateful to have known you. Thank you.

Chapter 1: The Social Politics of Knowledge on Cotton Farms in Telangana, India

Genetically modified (GM) cotton seeds have been aggressively adopted by Indian farmers producing cheap raw materials for the fashion industry. Such seeds give rise to cotton that eventually makes its way to Indian retailers and sometimes even stores like Baked T's, a custom design clothing shop on St. Louis' commercial Delmar Loop. By contrast, non-GM cotton seeds are planted mainly by organic farmers taking the first step in an international supply chain that can produce similar T-shirts sold by Plowsharing Crafts, a fair-trade, organic, and handicraft retailer across the street from Baked T's. The finished clothing sold by each store is not terribly different in quality or form. The true differences stem from the social relationships required to bring these different shirts to consumers. Participation in GM cotton farming or in organic cotton farming requires fundamentally different interactions between technology, governments, farmers, plant scientists, corporations, non-governmental organizations (NGOs), and advocacy groups. When we follow these threads back to the farm itself, behind each shirt lies not only a seed with different inherent properties but farmers participating in different kinds of agriculture that afford different possibilities for agricultural knowledge. These differences are the focus of this dissertation.

The cotton growers in Telangana, India with whom I conducted my dissertation research often experienced the first and last stages of the textile trade. They grew the cotton destined for new clothing and wore the used cotton clothes resold to poor people in the global South. Rather than focus on the clothes themselves, this dissertation asks about commodity chains in the opposite direction: What are clothing choices doing to farmers? How are decisions made in clothing stores and laboratories within a ten minute walk of my desk at Washington University in

St. Louis affecting how farmers grow cotton? What does this reveal about international development, the creation of ecological knowledge, and the adoption of technology in new contexts? This dissertation asks how farmers involved in mutually exclusive GM and organic cotton farming regimes are set forward on diverging paths because of the reward structure and constraints of these two types of farming. Because the same farmers are also growing rice, I also analyze rice as a comparative lens against which to compare the effects of cotton seed commodification and agricultural practice on farmer decision-making. Because the fundamental hinge that these farmers face involves which cotton seed they plant, I focus particularly on the ways that farmers create and adapt knowledge about seeds and farming decisions under the constraints of different crops, markets, farming strategies, development initiatives, and the social hierarchy of their villages.

I began this project in 2012, against the backdrop of a rising debate over hot environmental topics: climate change, population, and agricultural production. As the global population surpassed seven billion, fears of resource scarcity and overpopulation repeated a familiar spin in public discourse (Eng 2011; Engelman 2011; Kunzig 2011), focusing attention on the future of food and farmers. India has all of the right characteristics to capture a development imagination: high population, hundreds of millions of small farmers, an active democracy, an even more active press and civil society, immense wealth, immense poverty, a highly educated public, and vast human potential. Yet despite cries that the world needs GMOs to feed its growing population, Indian farmers grow GM cotton, not GM food[1]. Vested interests in the Ayurvedic industry tapped into nascent fears of GM food related to traditional Indian

[1]There are certain exceptions to this rule. Cotton oil seed cakes from GM cotton plants are a common additive to livestock feed, and so people may consume GM plant material indirectly through milk or meat. Goats, which eat almost anything, will eat cotton plants and so people may consume plant material through that route as well. Cotton seed oil is also increasingly used as cooking or processing oil.

understandings of food, nutrition, and the body (Kudlu and Stone 2013), blocking the first commercial foray into Indian GM eggplant. Globally, a plurality of GM crops are produced by the United States anyway, either destined to become oily and starchy processing ingredients or animal feed (Clive James 2010).

Despite cultivating one third of the land under cotton production globally, India's small farmers still have some of the world's lowest yields (USDA Foreign Agricultural Service 2015). In controlled field tests, studies have shown that both GM and organic cotton agriculture can increase yields (Eyhorn, Ramakrishnan, and Mäder 2007; Forster et al. 2013; Kathage and Qaim 2012), although some (Crost et al. 2007; Stone 2013) have argued that it is impossible to isolate GM cotton's role in those increases among a suite of other technological change. Globally, the push toward increased cotton production is ironic given that the world has produced millions more bales of cotton than it could spin into clothing since the 2010-11 season. By celebrating yield increases that coincide with the adoption of GM cotton, proponents aim to solve a production problem that, on a global scale, does not exist. Organic agriculture provides a new market that puts a premium on the producer, but it too is supplying a market that is already oversaturated.

Low yields notwithstanding, India is projected to lead the world in overall cotton production in 2015 and produces an astounding 74% of all organic cotton spun (USDA Foreign Agricultural Service 2015; Textile Exchange 2013). Yet, this has not necessarily reaped dividends for Indian farmers, who harvest yields less than half of those seen by their major competitors in China, Brazil, Mexico, the US, and Australia. There are many reasons for this comparative underproduction, foremost among them including the relative poverty of Indian farmers that leaves them vulnerable to environmental and social change and devastating insect pest attacks across the country. One potential future is offered by the high-tech science of genetic modification, which, according to proponents, combats rising pesticide applications by building a pesticide into the plant's genetic makeup. Organic farming, important for the analytic perspective of this dissertation but practiced on only .8 million of the 11.7 million hecatres on which Indian cotton is grown (Cotton Corporation of India Ltd. 2014; Willer and Kilcher 2012), illuminates another vision, in which farmers diversify crops and minimize inputs to maximize security. Both visions tie farmers to international markets and build on their ecological knowledge, and both have claimed widespread success. Although agronomists and economists have surveyed Indian smallholders over the short-term, anthropology is uniquely positioned to explore how these two futures affect farmer livelihoods and their sustainability for future generations.

Cotton's supply chain is long and complicated, and many of its aspects have attracted attention to workers rights and safety. Sweatshops, child labor, unsafe building conditions, and low wages all help to sustain an international trade in cheap clothing. At the same time that the fashion industry faces criticism for these abuses, shortened fashion cycles and a voracious global appetite allows the industry to continue a long history of cost-saving practices at producer expense (Beckert 2014). Various regulations and labels refer to different kinds of ethical cotton, from private labels like Fairtrade, which emphasizes worker conditions, to state-supported labels that identify the manufacturer and country in which the textile was made (Federal Trade Commission 2014). When consumers differentiate between GM and organic cotton, labelling can be more about declaring political allegiance than serving an agricultural purpose. GM cotton is produced under the conditions of industrial agriculture (Barlett 1989), and so organic cotton advocates would be disinclined to support GM cotton growers regardless of GM technology.

However, the additional element of genetic modification allows organic advocates to draw upon legal and biopolitical frameworks that oppose organic and GM technology specifically (Jasanoff 2005; Schurman and Munro 2010). The distinction between GM and organic cotton production systems is more fundamentally legal than agronomic. GM cotton seeds could be grown without the use of chemical pesticides and fertilizers if farmers so wished, but because GM products themselves violate organic certification farmers have no incentive to avoid the suite of fertilizers and pesticides designed to optimize the performance of GM hybrids. Indeed, the global conflicts between biotechnology interests and the environmental left in the 1990s encouraged both sides to shore up support and demonize the other camp (Jasanoff 2005; Schurman and Munro 2010). Correctly sensing that this polarizing issue would attract a wide audience, international organic regulation ultimately banned the use of GMOs.

The path of GM cotton marketing fit with the existing agribusiness model for clothing production: in reducing the need for bollworm pesticide applications, GM Bt[2] cotton technology aimed to keep clothing prices low. The biopolitical resistance to GM food consumption, ranging from eating the unnatural to supporting corporate overreach, does not apply as easily to cotton. The health benefits of eating organic food, namely a reduced risk of consuming certain pesticides, are also less clear in the case of clothing, which is washed and processed in several forms after cotton leaves the farm. Early promoters of Bt cotton rightly credited GMOs for initially reducing cotton's excessive pesticide applications (Qaim 2003; Huang et al. 2003), accounting for 34-39% of all pesticide use in India (Kranthi 2012) before Bt cotton's introduction in 2002. However, few of these production benefits or risks directly affected consumers.

---

[2] Bt refers to *Bacillus thuringiensis*, a bacterium from which genes coding for Cry proteins lethal to Lepidopteran insects are added to GM crops. The history of this is further discussed in chapter three.

Thus to establish themselves as alternatives and solutions to the problems facing global agriculture, GM and organic cotton narratives focus instead on the plight of farmers themselves. In this process, the seed became a symbol for their associated agricultural production generally, with a GM seed representing commodified farm inputs and externalized knowledge and a non-genetically modified seed representing an organic, low-cost, non-industrialized alternative. As with worker-centric labeling like Fairtrade, organic agriculture promoters wanted to focus the debate on farmer producers. Such a focus asked consumers what kind of agriculture they wanted to support, and in doing so aligned them with competing international debates about agricultural futurism and development. The battle for hearts and minds in these competing visions would take place on the grounds of yield, public health, development, and sustainability. Competing short-term and now medium-term yield studies generally indicate an uptick in yield since 2002 (Herring and Rao 2012; Qaim 2003; Qaim and Zilberman 2003), although the extent to which Bt cotton can account for this increase and why yield would drop once Bt cotton became ubiquitous by 2009 is unclear (Crost et al. 2007; Gruère and Sengupta 2011; Kathage and Qaim 2012; Stone 2015). Organic cotton appears to yield less under most circumstances, not necessarily because it lacks Bt cry toxin defenses but because organic cotton lacks many of the fertilizers and pesticides that give GM farmers a production advantage. Furthermore, many organic programs recruit impoverished, non-irrigated farmers whom one might expect to have poor yields to begin with. Under the right circumstances, some (Forster et al. 2013) suggest that organic cultivation is not too far below that seen with GMOs. However, I would add two anthropological caveats to such studies. First, the emphasis on yield may provide a benefit to farmers growing cotton, but yield increases are a strange goal during a five year cotton glut. Second, when yield is so dependent on socioeconomic resources that enable farmers to provide ideal conditions, yield is less a measure of how farmers are advancing than of where they fit into village or regional social hierarchies.

Therefore, I argue in this dissertation that this discursive separation of GM and cotton agricultural methods misses the point. Explaining agricultural production in terms of technological methods, including the 'hardware' of GM seeds, chemical fertilizers, or vermicompost pits and the 'software' of regulatory structures that certify agricultural products or allow germplasm to flow between continents, gives the impression that the technology itself does the farm work. In reality, these different technologies are used in very different ways and have a wide range of effects on agricultural practice, productivity, and sustainability. In each case, the question of production in agriculture is not an ecological or economic evaluation of a technology existing in a vacuum but a sociocultural question of farmer knowledge guiding farmer implementation. The ultimate sustainability of agricultural production is thus an anthropological question, hinging on farmer skill (Netting 1993) and the ability to adapt that skill in a dynamic environment (Richards 1985; Leslie and McCabe 2013). While agricultural skill, the flexible set of adaptive strategies that facilitates environmental management on small farms (Brookfield 2001; Richards 1985; Scott 1998), has been well studied, the process by which this skill is created remains more elusive. GM and organic cotton-growing farmers provide an insight into what Glenn Stone (Stone 2016), referencing theories of cultural knowledge from Boyd and Richerson (1988) and Rogers (2003), has described as three kinds of learning: environmental, social, and didactic. This dissertation investigates these different modes of learning as they are experienced by farmers involved in GM cotton cultivation, rice cultivation, and organic cultivation. I argue that the ways in which farmers balance these different kinds of learning, as they manage an agriculture defined by the differing social politics of GM cotton, rice, and organic cotton, determines the kind of knowledge that farmers can develop. As such, that balance determines the conditions of each technology's sustainability.

The Political Ecology of Expertise

This study of agricultural knowledge is couched within the broader theory of political ecology (Blaikie 1985; Robbins 2004), which presupposes that human/environmental interactions are not *natural* so much as *political*. That is, these interactions are based in a social history and cannot be reduced to causal relationships between individuals and ecological systems. Poverty or agricultural productivity are thus not problems that can be easily solved with new technologies because they do not address the underlying causes of these social ills. And yet agricultural development in India, building on modernist trends in the early 20th century through the Green Revolution and its aftermath, has focused on a series of technological innovations. Like farmers in Africa, Latin America, and elsewhere in Asia, British colonial policy and the geopolitics of the Green Revolution had already established a narrative in which Indian farmers were poor, ineffective, ignorant, and in dire need of modern expertise (Cullather 2013; Guha 2008; Gupta 1998; Perkins 1997; Ross 1998). Proponents of political ecology would argue that Indian farmers' poverty required more systemic solutions than new seeds and new fertilizers, which assume that production is a function of the materials rather than a function of social relationships.

Yet technological solutions served many vested interests. Agribusiness could continue to sell discrete elements of agricultural production including seeds, fertilizers, pesticides, and machines; India could continue providing development infrastructure like irrigation projects, roads, or attractive international financing; scientific agricultural researchers could find new and innovative ways to develop technologies ranging from seeds to inputs to planting strategies; international development advocates could fundraise for and provide deliverable solutions to neo-Malthusian production failures for India as a stand-in for the global South generally; and all of this trade and interest would help India generate revenue and exports as a rising economic power on the world stage. The extent to which farmers themselves benefit from such technological interventions is less clear, and I seek to problematize the assumption that new technology is superior or that it effects change independent of the social relationships in which it is embedded.

Cotton agriculture has a long history in India but by the late 1990s, Indian cotton farmers faced an internationally publicized crisis marked by low yields, high pesticide inputs, debt, and suicide. India's history of poverty, high population density, and famine provided the ideal backdrop for an emerging narrative: India (and therefore developing nations generally) needs to use technology to improve agriculture to meet its growing needs. Although I am writing critically about this narrative, Indian cotton farmers certainly faced problems. Pesticide use steadily rose through the 1990s (Kranthi 2012), and although India was and is among the world's top cotton planters by acreage, India had and continues to have low yields (Cotton Corporation of India Ltd. 2011; USDA Foreign Agricultural Service 2015). This dissertation focuses on seeds as synecdoches, representative elements part of larger regimes of technological and social relationships. Thus do GM cotton seeds, rice seeds, and organic cotton seeds bring farmers into connection with a variety of experts, consumers, and opportunities to build local environmental knowledge.

GM cotton offers farmers a vision of the future that is both radically different and completely in line with how farmers have learned to produce. Far more specific and controlled than traditional population improvement or even public sector plant breeding, GM technology gives agricultural scientists exact control over some aspects of certain genetic traits. For Indian cotton, at the present, this trait is pest resistance. In the larger political ecology of Indian cotton agriculture, pest resistance was particularly desirable because the traits could be bred into the growing hybrid cotton seed market, further encouraging farmers to adopt hybrids' associated social relationships to authority and expertise. I will expand on this claim further in chapter three. Farmers who plant monocultures of cotton hybrids bred to respond to the right combination of fertilizers and irrigation rely on pesticides to keep their plants safe from the combination of bollworms, sucking pests, and other insects that would feed on their crop. All of GM farmers' key inputs come from experts external to the household: pesticides and fertilizers from shops, machines from local dealers or rich farmers, seeds from laboratories, and even planting density from extension services. Seed selection, arguably the most important choice that farmers make, turns out to be socially mediated, with advertisements and the undue influence of rich or important farmers swaying villages and even districts to plant seeds with great enthusiasm before switching to a different seed the following year (Stone 2007; Stone, Flachs, and Diepenbrock 2014). As I will show in chapter five, socially important members of the village can sway other farmers to choose particular seeds despite wholly ambiguous results. Despite the confusion and anxiety that surrounds and obscures cotton seed decision-making, the same farmers show consistency and confidence with their rice seed choices. Some of this difference stems from the inherent properties of rice and cotton agriculture, but far more can be attributed to the social dynamics of marketing, herding mentality, and expertise between these two crops. Decisions about cotton, the quintessential cash crop, have devolved into herding dynamics subject to the whims of advertising, experts, or sheer circumstance (Stone 2007; Stone, Flachs, and Diepenbrock 2014). Decisions about rice, a more flexible commodity, are less swayed by herds or experts. The differences in social authority for each crop ultimately compound in differences in the way they are managed.

But what of the social life of seed knowledge on a farm where choices are severely limited? Like GM technology, organic agriculture regimes offered farmers a future both in line with the past and radically different. In a very real sense, the international organic movement in agriculture began in India. After years of service in British India, agricultural officer Albert Howard concluded that England could learn much more from India than he could teach South Asian peasant farmers. Howard's *Agricultural Testament* galvanized a nascent European organic movement that quickly spread to the United States and morphed into a well-regulated international network of certifiers, regulators, producers, and distributors (Conford 2011). After half a century, a heavily regulated version of organic agriculture found its way back to India and became nationally institutionalized in 2002, the same year that GM cotton was commercially released. On organic farms, as on all farms, the choices that farmers make pass through many levels of social mediation: caste, farmer holdings size, scientific development and advising back at plant science stations, etc. But on organic farms, farmers must additionally conform to organic regulations, perform village life and gratitude to visiting donors or buyers, and provide the image of tradition or development that consumers in the international organic cotton trade hope to buy (Franz and Hassler 2010). Various aspects of agricultural knowledge are not merely socially mediated, but actively taught on these farms. Thus, the shifting target of success that farmers hope to achieve can depend as much on being a good student as being a good farmer. The history and development of these mutually exclusive regimes will be explored further in chapter three.

To view either organic production or conventional production now including GM seeds as technologies distinct from a social context would leave out the most important criteria for their success on farmer fields. Bt cotton's actual role in pesticide decreases and yield increases is disputed (Kranthi 2012; Stone 2011a; Kathage and Qaim 2012; Stone 2013), in part because it is difficult to parse out the individual effects of a new seed or a new spray. GM technology is only relevant to farmers in so far as it can be distributed, trialed, and effectively filtered through the social politics of shops, extension offices, laboratories, and caste relationships. Similarly, numerous studies of organic production highlight the benefits of household-produced farm inputs and diversified planting strategies (Eyhorn, Ramakrishnan, and Mäder 2007; Forster et al. 2013; Raghupati and Prasad 2009; Desmond 2013) without considering the ways in which farmers use organic initiatives as opportunities to gain social or economic resources. Studies of particular organic programs can posit their success as a technological advancement rather than a successful partnership between farmers, consumers, and NGO or corporate promoters. In focusing on practice, on what people do in quotidian life, anthropology gives a complicated answer to a relatively straightforward question: given new technologies, how do farmers respond to different relationships of agricultural knowledge and authority?

Knowledge and Authority in Cotton Agriculture

In this dissertation, I investigate the social politics of knowledge and authority on cotton and rice farms in Telangana, India. I do this by filtering the daily experience of agricultural decision-making and farmer experimentation through the lens of Stone's tripartite framework of environmental, social, and didactic knowledge and his comments on agriculture and performance (Stone 2016; Stone 2014). This dissertation is therefore fundamentally about knowledge and the ways that farmers put that knowledge to use. I use three seeds enmeshed in different social politics, GM cotton, rice, and organic cotton, to investigate:

1. Under what situations conventional and organic farmers use a balance of environmental, social, and didactic knowledge to make agricultural decisions
2. How farmers learn to perform certain roles, most importantly the role of the transformed farmer and the role of the "show" farmer under particular didactic conditions
3. How this agricultural knowledge, and therefore the sustainability of agricultural technology, is contingent on environmental learning not being overwhelmed by social or didactic feedback.

GM seeds were introduced to the Indian cotton market as a solution to low yields and high pesticide sprays, but they were soon sold as a technological fix to a more general agrarian distress symbolized by farmer suicide – GM seeds aimed to provide sustainable solutions to poverty and pesticide overuse (Pearson 2006). Organic cotton programs conceptualized sustainability differently, informed by the anti-GM environmentalist discourse of the 1990s and capitalizing on conspicuous, socially-minded consumption. Organic seeds, and more importantly organic agriculture interventions, aimed to educate farmers and decrease their dependence on multinational agribusiness in favor of alternative and NGO marketing. When the same farmers plant rice seeds, they experience a radically different market and learning process, not the least of which because they are often purposively saved and replanted by farmers, requiring a very specific set of ecological knowledge. This is why cotton presents such interesting challenges for food and agricultural sustainability writ large – changes in cotton, first as a hybrid and now as a

GMO, or cotton as a niche product in organic markets, may portend the current push for hybrid and GM rice and the backlash to it.

GM and organic cotton planting regimes employ different kinds of technologies on the farm as these regimes are based within different visions for the future of agriculture. GM cotton growers, of course, use Bt seeds, but their cultivation is also related to a series of integrated pesticides and fertilizers, the network of shops and extension agents who advise and sell to them, and a prerogative to grow and sell as much cotton as possible on their land. These farmers often cultivate other crops including most significantly rice, which can be saved, is often eaten, and is less of a high-risk, high-payout gambit. Because the agricultural calculus for rice is different than that for cotton, a comparison of these two crops allows me to test how conventional farmers are learning differently about these two crops and applying that knowledge. Among conventional farmers planting rice and GM cotton, Stone (2007) argued that farmers over-rely on social learning when choosing cotton seeds because the seeds are unrecognizable, inconsistent, and rapidly changing. A null hypothesis that would assume economic rationality in cotton choices, namely farmers determining seed choices based on good yields, does not make sense in an environment defined by poor environmental feedback and unreliable consumer choices. Rice, however, should be a more trialable crop. My more direct comparison of rice and cotton in the context of agricultural institutions like shops and extension services highlights the role that expert knowledge plays in farming decisions. By analyzing how farmers respond to environmental and social feedback with rice and cotton, I can better understand how and why the same farmers, and farmers as a whole, know more about rice than about cotton. Just as conventional farmers have to deal with didactic expertise in shops and extension services, the same environmental and social learning systems are at play on organic farms. The technologies differ but the same necessity to balance and learn from didactic, environmental, and social sources remains. Conventional farmers plant exclusively Bt cotton and rely on shops or other farmers for knowledge about the commodified inputs that they use to help that plant grow. In rice, a narrower set of seed options gives an opportunity for a wider knowledge base about any particular seed. This would suggest that farmers can develop agricultural knowledge in a less confusing marketplace. Organic farmers are restricted to a scant few cotton choices and plant either the same rice varieties that conventional farmers plant or a combination of heirloom rice and sorghum varieties. However the social and environmental learning opportunities suggested by the GM planting farmer analysis are overshadowed by a didactic intervention program with a mission to both educate farmers and maintain organic standards. Because farmers are rewarded by organic intervention programs for correctly following project rules and for performing for curious visitors, some enter into a feedback loop of show and reward: charismatic farmers learn to act transformed by the intervention, extol the virtues of organic planting methods, are then rewarded with extra sales, farming infrastructure, and local fame for their diligence, and become more committed to the project. Thus do farmers learn that to be a good organic farmer means to be a good showman.

By comparing the learning process across several different situations: rice vs. Bt cotton, organic rice and sorghum vs. organic cotton; organic farmers vs. Bt planting farmers; different kinds of organic farmers vs. different kinds of Bt planting farmers, I can draw wide conclusions about how and when farmers can learn and apply environmental knowledge. More importantly, these lines of comparison also provide insight into the influences that didactic, social, and environmental knowledge have on one another, emphasizing that skill, a balance of all three types of learning, is contingent on the reward structure of farmers' social environment. What farmers learn on the farm is highly variable, depending on the trialability of the technology in question, the authorities with whom they work, the rewards for agricultural and social performances, and the risks of screwing up within the production regime. Having introduced my guiding research question and conceptual framework, I will summarize the chapters.

Chapter Summary

This dissertation is split into four thematic parts. The first part, chapters one and two, introduce the theoretical lens for this research, describe the research site, and detail the research methodology used in this project. In the second section, chapters three and four, I discuss the historical, political, and theoretical context of this research. Chapter three considers both organic and GM regulation in India as a function of their political ecology. Regulation and germplasm flowed across the longstanding botanical and political ties between the United States and India, especially as regards cotton. Beginning in the mid-1800s but accelerating after Indian independence and the Green Revolution, American and European foreign policy has played an important role in agricultural development in India. Both the spread of GM and organic technologies reflect a push for sustainable agricultural development, and the foreign regulatory structure of both agriculture systems has been modified by India's uniquely contestable and public regulatory apparatus. Chapter four provides a theoretical context for this paper within the anthropology of knowledge and socio-environmental resilience. Fundamentally, anthropology asks how people live within global trends like capitalism, colonialism, and global development. To understand how global initiatives in agricultural development are affecting farmer lives, I focus on farmer learning as a lens to understand how people understand, adapt, and react to GM and organic agricultural systems. This section draws heavily on anthropological theory, particularly Stone's tripartite theory of farmer learning, and the history of transnational agricultural development.

The third section includes chapters five, six, and seven, and explores the social politics of farmer learning in the context of GM cotton, OPV rice, and two types of organic cotton farms. Chapter five describes the breakdown in environmental learning and the largescale shift to social learning among GM cotton farmers. While all farmers appear to have difficulty trialing seed technologies or even associated cotton management strategies, large, wealthy, and socially important farmers appear to exert undue influence on what seeds become popular when. This influence appears because of the social politics of knowledge and seed buying, even though these influential farmers see no yield benefits, leaving them to be just as unsure as their smaller, poorer, less influential neighbors. In rice cultivation, discussed in chapter six, farmers are less singularly focused on yield while their rice crops are themselves inherently easier to trial and learn from, in part because farmers look to the same phenotypic traits for agronomic success that buyers look for in the market. Additionally, many farmers purposively save rice seeds, making rice and the knowledge of its management less commodified than GM cotton. Chapter seven discusses the ways in which farmers learn how to work with new kinds of plants, authorities, and incentives that underwrite their production on organic farms. Here, more than among conventional GM planting farmers, learning to perform for visiting buyers and learning how to work with agricultural institutions is just as important to farmer success as making well-informed seed choices. All three chapters draw heavily on data collected as a participant observer of farmer experimentation as well as my survey data. Each chapter measures yields and seed choices with some degree of statistical analysis while placing those numbers in their ethnographic context.

Chapters eight and nine address the final themes of show and performance in agriculture, drawing mainly on interviews with experts and ethnography of the ways that farmers navigate the social politics of agricultural knowledge in Telangana. Chapter eight explores Stone's (2014) concept of the show farmer, the especially charismatic individuals who chase or attract media attention and social recognition for their agriculture. Many such farmers become skilled performers and their personality shapes the narrative of agricultural development, village development, organic agriculture, or GMOs generally. However, such farmers are not necessarily representative of the village as a whole. Chapter nine explores the effects of performance and transformation in a development context more broadly, treating these as phenomena experienced to some degree by most farmers. Because these chapters look at performance and farmer narratives, they rely most heavily on qualitative ethnography and interviews.

This chapter has introduced my research context and goals. The following chapter introduces my methodology and field site in greater detail. In this dissertation I contextualize qualitative and quantitative data on the farmer learning process within environmental, social, and didactic learning to better understand how agricultural technology works on the farm. Although I discuss my research methodology throughout this study, I will briefly summarize my methods in the following section.

Chapter 2: Site Description and Methodology

This dissertation focuses on three districts of India's newest state, Telangana, formerly the north-central region of Andhra Pradesh. Because of funding opportunities (and constraints), I structured my research to take place over twelve months and three consecutive cotton-growing seasons 2012-2014. I visited four villages in 2012 June-August, nine villages in 2013-14 July-February, and seven villages in 2014 May-August. This diachronic approach allowed me to see changes in seed choice, analyze seed recall, and develop long term relationships with the farmers that were patient enough to donate their time and energy to my research.

India has sustained a secular democracy built by countless ethnic and religious factions and a population in which hundreds of millions of agrarian laborers had never received formal education (Guha 2008). Muslim Nizam-ruled Hyderabad, independent India's largest princely state, remained independent and defied efforts at unification for over a year as modern India coalesced in 1947. Threatened by a Muslim-dominated, potentially hostile nation bisecting the new country, Indian troops stormed the Nizam's palace in Hyderabad, claiming the former state as part of India on September 17th, 1948 (Zubrzycki 2007). On that day, the Deccan plateau, a majority Hindu agricultural area dominated by Muslim and British influence for nearly 700 years, suddenly became part of a Hindu-led secular democracy.

Outside of Hyderabad city, the politically active citizenry also supported the rising Indian communist party, which called on peasants and women to overthrow their oppressive landlords and various systems of exploitative bonded labor (Lalita et al. 1989). In the riots that followed, the people of the new state killed thousands of former Muslim and Hindu landlords. Historically dominant ethnic Andhras and historically subjugated tenant farmers and Tribal (Adavasi) peoples in the interior of the Deccan plateau achieved an uneasy peace by making Hyderabad the capital of the new state of Andhra Pradesh (Zubrzycki 2007; Guha 2008; Ram 2007). While the state itself was unified on linguistic grounds, a sizable minority in Telangana agitated for a separate state. On July 30, 2013, the central government in coordination with the ruling Congress party began plans to bifurcate the state (The Hindu 2014; Vijay 2012; The Hindu Business Line 2014). On February 18, 2014, the legislative assembly, the Lok Sabha, passed the Andhra Pradesh Reorganization Bill to officially split the state on June 2, 2014 (Reddy 2014; Joshua and Reddy 2014).

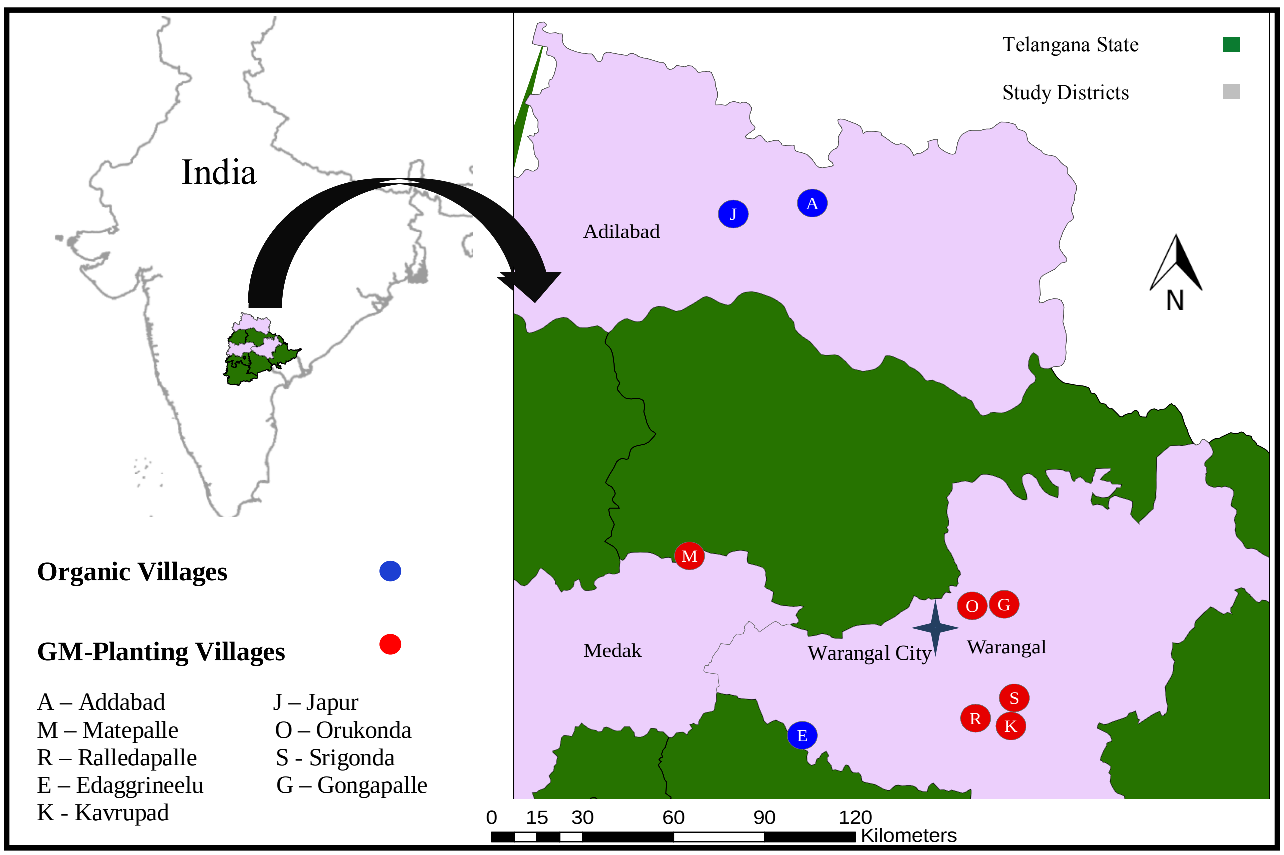
While Hyderabad has become a hub for India's IT boom, the surrounding area of the Telangana region has remained comparatively underdeveloped with a largely agrarian base, poorly irrigated (Vakulabharanam 2004), and home to a disproportionate number of farmer suicides in the state (Galab, Revathi, and Reddy 2009). After bifurcation this agricultural-industrial divide remains: the Telangana region supports the majority of cotton producers while the Andhraylseema region is home to the majority of cotton mills (Kurmanath 2013; Mitra and Somasekhar 2013). To maintain control of a state won by courting rural voting blocs, Telangana politicians have to aggressively support policies that please cotton farmers as they incentivize links between industry and agriculture: subsidies on agricultural chemicals like fertilizers and pesticides, a continued under-market maximum retail price for cotton seed, a high minimum support price for sold cotton, and continued subsidies on electricity and irrigation.

Study Villages and Village Sampling Strategy

Building off of Stone's (2007; 2011a) work in the Warangal district, my sampling strategy aimed to expand research on GM cotton planting farmers and compare their experiences to two kinds of organic cotton projects. I surveyed six GM cotton planting villages along with three organic cotton planting villages. Several distinct groups of houses, especially among scheduled tribe (ST) farmers, can thus compose one village. These villages were selected for continuity with Stone's work and reflect the diversity of social, agricultural, and economic opportunities that Telangana farmers face. Stone initially selected these villages to survey farmers working with a variety of different soil types amenable to cotton agriculture; differing access to village infrastructure including electricity and irrigation; a range of experience growing cotton; and different ethnic compositions. The particular rationale for each village will be explained below.

In each village, I spoke with farmers randomly drawn from a recent census or village polling record stratified by wealth. In villages where I worked with farmers that Stone had previously met, I endeavored to meet as many of those same farmers to collect comparable data. In cases where people in Stone's sample had died or moved, I interviewed sons or other relatives when applicable to collect data on long term agricultural management at the household level. Other farmers moved away or discontinued farming, and so I chose other people from the randomized census and voting lists. I chose these particular GM cotton planting villages as they represented a range of villages near regional cities, rural villages with paved roads, reliable bus routes, electrical infrastructure, and irrigation, and rural villages with comparatively little infrastructure. These are labelled as town, rural town, and rural respectively in **Table 2.1** below. These differences in proximity to cities and in-village resources create different agricultural possibilities for farmers, including access to off-farm experts and agricultural inputs. These in turn affect farmer management and decision-making. I chose these particular organic villages because they represent farmers working with didactic NGOs as well as corporations. Using a combination of previously interviewed farmers and others drawn from the randomized lists in Ralledapalle[3], Gongapalle, Kavrupad, Orukonda, and Srigonda, and creating my own random sample in Matepalle, I surveyed 60 people in each GM planting village. In the smaller, rarer, and more isolated organic cotton planting villages, I spoke with all or ~90% of the organic farmers in the village. Although my work is in conversation with Stone's seed choice data beginning in 2004, I do not draw on it directly in this dissertation. I focus specifically on structured surveys conducted 2012-2014 (**Figure 2.1**), in which I asked 394 GM cotton planting farmers about 4,599 seed choices and 108 organic cotton planting farmers about 851 choices (**Table 2.1**).

Figure 2.1: Map of Research Area



[3] All village names, interlocutors, and NGO names have been changed in the interest of anonymity. I have not changed the name of official government organizations or bureaucratic offices

Table 2.1: Village Distribution of Farmer Respondents

	2012 farmer n	2013 farmer n	2014 farmer n	Ethnic composition	GM or Organic	Village Type[4]
Kavrupad	54	66	63	Caste/Tribal	GM	Rural Town
Ralledapalle	49	62	59	Tribal	GM	Rural
Srigonda	49	69	61	Caste/Tribal	GM	Rural Town
Gongapalle	40	60	60	Caste	GM	Town
Orukonda	X	60	56	Caste	GM	Town
Matepalle	X	60	X	Caste	GM	Rural Town
Edaggrineelu	X	33	X	Caste	Organic	Rural
Addabad	X	35	35	Tribal	Organic	Rural
Japur	X	35	35	Tribal	Organic	Rural

Ethnic distinctions are a particularly important social variable that manifest in differences in village locations and access to resources or infrastructure. Although caste discrimination has been officially outlawed since the 1950s, historical disenfranchisements ripple into the present in the form of generational wealth and status. The Indian census is broken into three caste categories and a category reserved for tribal farmers not belonging to the formal caste system: scheduled castes (SC), the lowest castes of people formerly called untouchable or *harijans*; backward castes (BC), less disenfranchised people historically working in commerce and agriculture; and open castes (OC), who do not receive caste-based benefits or reservations in government or university settings. Members of Scheduled Tribes (ST) in rural Telangana live outside the village on more marginal land, follow different customs, and often speak a different language than the majority Telugu. Many OC farmers would have previously been primary landowners or skilled workers in the village. These differences have a contemporary impact on

[4]Rural town here refers to rural villages at least 40 minutes to the nearest minor city but with reliable electricity and transportation routes. Town refers to villages within 20 minutes of the nearest minor city. Rural refers to villages lacking reliable transportation or electricity, where population density is lower. The differences and meaning of those differences between village types and ethnicities will be explained in greater detail below.

the infrastructure and resources available to these communities. Kavrupad, Srigonda, Edaggrineelu, Gongapalle, Orukonda, and Matepalle are villages primarily populated by people who belong to the caste system. These villages have paved roads, reliable electricity, small restaurants and shops, schools, public resources like toilets, and most houses tend to be concrete or brick with tin or concrete roofs.

Kavrupad, Matepalle, and Edaggrineelu are all rural caste villages at least an hour from regional cities where one will find fully equipped hospitals, commodity markets, transportation hubs, shopping malls, air-conditioned movie theaters, and other amenities common to major cities worldwide. Farmers in Kavrupad and Matepalle are almost exclusively GM cotton and rice farmers while Edaggrineelu farmers farm primarily organic cotton and rice. Close to the mandal headquarters of Parvatagiri, Kavrupad benefits from a well-regarded NGO run school and junior college (equivalent to US 10-12th grade). Due to the influence of a wealthy family from the village now based in Hyderabad, Kavrupad has benefitted not only from a series of construction project improvements but also from foreign interest and investment spurred on by the school. In 1996, this family, former major landowners, transformed some of their land and their former home into a large primary school complex. I myself taught at Kavrupad's school twice a week while conducting interviews and have donated to their programs. Similar to most Telangana caste villages, SC, BC, and OC people tend to cluster near others of similar caste, and each caste area has kiosk shops and minor temples. Kavrupad has one seed and agricultural input shop, although most farmers view it and the owner with some suspicion and prefer to buy seeds from Warangal when given the chance. Kavrupad farmers grow cotton on mostly red clayey soil and reflect a diverse caste and socioeconomic spectrum. Kavrupad provides a particularly interesting comparison to nearby Ralledapalle, discussed below, because of the similarity in agricultural conditions and the dissimilarity in ethnicity and infrastructure.

Matepalle village in the Medak district also benefits from the same NGO and foreign investments as Kavrupad and in 1998 began accepting students into its own school, which was building a new and much larger space in 2013. Housing and electricity are comparable to Kavrupad, although many young Matepalle men seek work in the Middle East, especially as part of Kuwait- and Qatar-based construction teams. Unlike Kavrupad, which sees several buses each day to nearby cities, only one bus in the morning and evening connects Matepalle to urban resources. Matepalle has no input shops around which farmers congregate as in Kavrupad, but it does have a popular tea shop/bar where farmers will gather to read the newspaper and discuss farming problems. It is thus especially rural when compared to Kavrupad. Matepalle farmers similarly grow cotton on mostly red clayey soil and reflect a diverse caste and socioeconomic spectrum, although they are relatively more rural than Kavrupad famers.

Edaggrineelu, an organic-growing village, is technically closer to the nearest city, but is several kilometers away from any bus routes. Residents (and visiting anthropologists) rely on autorickshaws or passing trucks and tractors for transportation, in addition to walking or riding in bullock carts. Edaggrineelu is much smaller than either Matepalle or Kavrupad villages, each of which are home to hundreds of households. Edaggrineelu has only a few dozen households, all but one of which are involved with organic agriculture. Edaggrineelu's farmers are thus more closely related and socially intertwined. Caste differences are also less pronounced in this village, where almost everyone is either SC or BC and so former OC landowners exert less social influence within the village. Unlike Kavrupad or Matepalle, Edaggrineelu's small size precludes functioning schools and shops. Edaggrineelu's relative lack of infrastructure, low caste status, and isolation made this village all the more appealing to PANTA, the NGO that initially promoted first integrated pest management (IPM) and later uncertified organic agriculture. By establishing Edaggrineelu and other such organic communities as underdeveloped in their promotional materials, NGOs promoting organic or Fairtrade agriculture establish two important marketing goals. First, they pull on the heartstrings of urban or international consumers by using images of poverty when selling clothing at higher rates. Second, they position their own work as a necessary and effective form of development in need of support by conscientious consumers. While establishing the underdevelopment of such villages is an important companion to certified organic programs seeking to attract attention in the marketplace, these efforts are even more important for an uncertified village like Edaggrineelu, where trust in the development efforts of the NGO are the main justification for adding value to Edaggrineelu's agricultural products.

The village of Srigonda is just as far from the nearest city as Kavrupad, but benefits from a large OC population of ethnic Kamma caste people who migrated to this region from comparatively better developed and richer coastal Andhra. Srigonda benefits from an agricultural cooperative that works to obtain high-quality chemical inputs and seeds at a slightly reduced price, saving farmer members anxiety and travel costs. This cooperative was established in cooperation with the Warangal plant science station, which added agricultural scientists to the mix of high-caste farmers and reliable technology. Although agricultural conditions are roughly similar in Kavrupad and Srigonda, although farmers from both villages report that Srigonda has greater access to fertile black soil that supports high cotton production, Srigonda farmers are locally famous for being skilled cultivators. The cooperative, which provides loans and equipment in addition to input reliability, helps to address farmer concerns and provides a congenial meeting ground for Srigonda farmers, many of whom are related to the shop manager.

Gongapalle and Orukonda are both much closer to Waranagal and benefit from more highly developed town infrastructure and more regular bus transportation. Both villages are within 20 minutes of urban resources and agricultural extension services. Due to their proximity to the city, these villages are more reliably electrified, offer more robust local markets, can more easily do business with urban sellers and buyers, and are larger and more densely populated than Kavrupad, Edaggrineelu, Srigonda, or Matepalle. Real estate values and job opportunities are both comparatively higher in these villages as well, affording Gongapalle and Orukonda more opportunities for wealth and construction. Like Srigonda, these villages benefit from black soils suited to cotton cultivation.

By contrast, ST communities living in my research area live in hamlets (*thandas*) adjacent to villages with poorer infrastructure and poorer access to shops and transportation routes. Roads tend not to be paved, buses have no stops in the *thandas*, electricity is less reliable, businesses do not set up shops, and houses are a mix of concrete, brick, mud-brick, tin, wood, and thatch. *Thandas* throughout Telangana were established on more marginal hilly or red clay soil and so ST villagers typically travel to towns for most services and for transportation to nearby cities. There, ethnic ST people who speak the state language of Telugu as a second language, may face derision from shop owners or higher-caste residents who see them as unwelcome, lower class others. During my observations in agricultural input shops, sales representatives were often dismissive or openly hostile to ST buyers, who largely sought to finish their transactions as quickly as possible and leave the shop. After they left, shop owners would often turn to me and make disparaging remarks about ST farmers, calling them ignorant and backward. Ralledapalle's cluster of *thandas*, Munjala Kunta *thanda* outside of Kavrupad, and Champla *thanda* outside of Srigonda are almost exclusively populated by ethnic Lambadi or

Banjara people. Categorized as a criminal tribe under British leadership, speaking a different language, and with a different set of religious and social traditions, Lambadi people settled outside main Telangana villages after migrating from the state of Rajasthan in the early 20th century (Naik 1983; Naik 2000). Like other marginalized communities, ST people are given special consideration for government and university positions. Because many ST people live on more marginal farmland in hill areas or near forest areas, many also benefit from special allowances to use those forest resources and work land that would be illegal for non-Tribal farmers to use.

Socioeconomic differences exist within the *thanda*s, but Lambadi farmers do not distinguish by caste in the same formal way as found in the villages. Because they lack this particular form of social differentiation and because members of a particular *thanda* often share kinship through the few settling families who founded each particular hamlet, *thanda*s tend to be more socially egalitarian. While relatively poorer and without deep social roots in Telangana, Lambadi farmers have historically remained within *thandas* and farm the areas immediately around their hamlets rather than joining villages. As village temples have particular caste rules attached to how one worships, important rituals in *thanda*s took place in *thanda* shrines and in Tribal languages rather than in the religious context of Sanskrit spoken by trained Brahmins. Villagers from Kavrupad, for example, almost never participated in Lambadi rituals or festivals while Lambadi people almost never participated in the religious rituals or festivals practiced by the inhabitants of Kavrupad.

Stone initially selected Ralledapalle as a comparison village to Kavrupad, as the villages have virtually identical soil conditions and lie just two kilometers apart. However, Ralledapalle and the surrounding *thandas* offer dramatically different socioeconomic possibilities.

Ralledapalle has a smattering of brick and concrete houses where some BC and SC farmers live, but most of Ralledapalle's population comes from Matya and Sitya *thanda*s, named for the patriarchs who settled them. Schoolchildren walk or ride buses and autorickshaws to Kavrupad and Parvatagiri for school, as the schools in the *thanda*s are poorly attended by either teachers or students. The same is true for Munjala Kunta *thanda*, which has no paved roads and only a few concrete homes amidst thatched roof mud-brick houses. Several years before this study Munjala Kunta *thanda* residents convinced the local government to build passable bridges and stretches of road, but these have since fallen into disrepair. In Ralledapalle, Munjala Kunta, and Champla *thanda*s, buses, cars, and autorickshaws avoid these routes in part because they would not be capable of travelling on them.

While Lambadi farmers as a whole often face difficulties in villages and cities because of ethnic and linguistic differences that cause shop owners to treat them callously, the Champla *thanda* farmers near Srigonda avoid this by taking part in the Srigonda cooperative. Ethnic Kamma caste immigrants, the OC farmers of Srigonda are less invested in local Reddy and Velama caste politics that would make social life difficult for Lambadi people, although they are often casually discriminatory toward Lambadi farmers. As members in the cooperative, Lambadi farmers have an economic stake in supporting this business and can feel more assured that they are treated with respect in the shop. This is not to say that casteism does not play into quotidian life in Srigonda or into interactions at the Srigonda Cooperative – it certainly does. However, Lambadi farmer members are more socially integrated with their fellow cooperative farmers than they otherwise would be living on the village margins. The differences in opportunities for travel, school, and infrastructure are extreme across these ethnic boundaries even when the actual distances are quite close.

Just as Edaggrineelu's isolation and low caste status made it an attractive village for organic NGOs to promote their development efforts to ethical consumers, so too do the isolation and ST status of Japur and Addabad make them attractive to certified organic programs. Farther north in the Adilabad district, these farmers belong to the Gondi tribe. Gondi people have much deeper roots in Telangana than Lambadi migrants (Mehta 1984), but like Lambadis their language and customs are different and their *thanda*s tend to be well removed from villages and their infrastructure. I worked with two *thanda*s, Madhyaguda (~10 households all practicing organic agriculture) and Mopalle (~40 households half of which practice organic agriculture) peripheral to the town of Addabad. Addabad is a small city with a lively market and bus station, but the thandas themselves have only intermittent access to buses and autorickshaw. It can take over an hour during the rainy season to reach the *thanda*s from Addabad, and local buses often refuse to make the trip citing a lack of interest.

Sompalle (~10 households all practicing organic agriculture), Sampalle (~10 households all practicing organic agriculture on some of their land), and Ranaguda (~20 households practicing organic agriculture in 2013 but not 2014) compose the Japur *thanda* and are similarly difficult to reach by bus or autorickshaw. In both villages in the Adilabad district, farmers work hilly, rocky soil that pools water and erodes quickly. Their proximity to forest areas provides an additional risk of pig and parrot predation, which farmers manage by sending family members, often but not exclusively young men, to sleep in bamboo stilted houses (*manda*) from which they sling stones at attacking pests. These Adilabad district organic farmers additionally lacked irrigation facilities and so relied entirely on rain for crop watering, with the exception of a few farmers who rigged motors to nearby seasonal streams. Farmer cotton yields in this area are predictably lower as a result, regardless of their organic imperatives to grow without chemical inputs or GM seeds. Farmers tended to grow heirloom sorghum rather than wet rice, although a few farmers cultivated a dry, non-irrigated rice variety. Due to their close relationship with organic NGOs as well as their geographic and social distance to input shops, most Addabad district organic farmers procured seeds through organic programs or their own stores. Tribal organic farmers in the Japur and Addabad thus had a very different relationship to infrastructure and agriculture than other Tribal farmers or caste farmers in the Warangal and Medak districts. Having briefly introduced the sites in which I collected farmer seed data, I will discuss the methodology I used to collect data on farmer decision-making.

Methodology

My research investigates the ways in which farmers develop and adapt agroecological knowledge within their global, local, political, social, and economic context. To understand how farmers made seed choice decisions and to place these decisions within village and global power structures, I employed a mix of quantitative and qualitative methods that allowed me to track different types of learning. Qualitative data methods include interviews, focus groups, and participant observation. Quantitative methods included ethnobotanical counts, geographic information system (GIS) data collection, household surveys of demographic variables, and seed surveys. Surveys for all data collection are appended (**Appendix A-D**). Data from these survey and spatial instruments provided information that could be statistically analyzed and give measurable weight to environmental feedback and social influence.

Such quantitative data in anthropology is necessarily messy because I relied on farmers to give accurate details for their fields and lives in areas where the farmers themselves do not keep accurate records. The surveys that I administered required that farmers develop justifications for their seed choices although they often have very poorly reasoned rationales for their seed choices because such information can be difficult to gather and even more difficult to trust. When asked to dredge up reasons for their seed decisions, many farmers respond that they are navigating the new rules of input-intensive agriculture by learning to take advantage of new incentives and social avenues to success, however they define success at the moment. Success was largely articulated as a good yield (Telugu: *manci digabatu*), a way to measure a return on one's investment and a visible indicator of one's farming prowess. Others are, most likely, 'just' making do – earning and working without the imperative to carefully document and analyze and improve every aspect of farm management as if these small farms were factories attempting to increase profit margins or prepare quarterly reports. Many farmers appear to be driven by a more anxious desire for success in an agricultural economy where the means to and meanings of success are not always clear. Wanting more can be very far from knowing how to get it and taking a series of clearly defined to steps to achieve it.

Although I only rarely conducted true participant-observation in the sense that I rarely picked cotton or plowed soil with bullocks, I relied heavily on the ethnography of these places to contextualize the data I conducted. In addition to the conversations that inevitably arise when getting to know people, I typically spent at least an hour with each farmer discussing aspects of life beyond the survey questions. Armed with this qualitative information I critically examined the quantitative seed choices that farmers mentioned during the survey, and vice versa. The gaps between farmers' professed logic and the three years of seed choices that I collected inform my ultimate conclusions on the social politics of cotton and rice choices, how these differ, and how organic farmers make decisions against the backdrop of conventional agriculture. Living in these villages, teaching school children, photographing weddings, planting seeds alongside farmers, and harvesting the crops gave me insights into daily life and the ways in which farmers approach their work that I would not have been able to document otherwise.

Although each survey was likely to turn into an extended structured interview depending on the farmers' time and patience in that particular moment, I also conducted and transcribed more formal interviews with shop owners, NGO officials, plant scientists, key informants on conventional and organic farms, and with five focus groups of five or more farmers (**Table 2.2**). I relied on these experts to provide an insider or entrepreneurial perspective on farmer seed choices and the influence of institutions like plant science centers or shops.

Table 2.2: Interview Structure

	2012 n	2013 n	2014 n	Interview type
Plant scientist	3	5	7	Semistructured
NGO representative	2	10	6	Semistructured
Foreign cotton buyer	X	5	1	Unstructured
Shop owner	7	15		Semitructured
Farmer focus group	2	X	5	Semistructured
Conventional farmer key informant	8	10	8	Informal
Organic farmer key informant	X	5	4	Informal

These qualitative observations and discussions informed the quantitative meat of my analysis, which I conducted in the form of various surveys. The primary survey was a relatively simple one-page survey asking: what cotton and rice seeds farmers planted in the given year, where they procured these seeds, how many years they had planted these seeds, and all of these details for the previous year along with yield, pest, and pesticide spray information. This survey design allowed me to follow up with farmers to check seed recall in subsequent years, compare yield data over time, and track rice and cotton seed choices. When analyzing this data, I separated seed choices into those recalled from the previous year, suitable for discussing farmer responses to yield and pesticide applications; and those chosen in the current year, assumed to be more accurate and better suited to discussing decision making and seed faddism. Each year the survey questions changed slightly in the interest of better wording or more complete demographic or seed information, although the core questions of seed choice, yield, seed vendors, and years planted remained the same.

In 2014 I additionally asked farmers to answer questions about phenotypic characteristics of their rice and cotton seed choices so that I could measure their degree of consensus for these seed qualities. During my shop surveys, I asked similar questions to determine if shop managers believed that any particular seed had an inherent edge over others as well as questions that asked for shop owners' opinions on seed fads, marketing strategies, and farmer motivations. Finally, during the 2013-14 season I asked 65 Kavrupad and Ralledapalle farmers, half of the larger sample and representative of all castes, landholding quintiles, and representing the range of variation in cotton and rice yield productivity in the total sample, about demographic variables including income, debt, assets, education, and labor relationships. I draw on these numbers in coordination with ethnographic research when talking about such household demographic information for caste or tribal farmers generally.

I asked organic farmers and farmers in Kavrupad and Ralledapalle to freelist non-crop plants that they used, managed, or cultivated in their cotton and rice fields. This, in coordination with participant-observation and key informant interviews allowed me to generate an agrobiodiversity checklist. Because Telangana cotton farmers often find gaps (Telugu: *poguntalu*) in their field after they plant cotton, those farmers regularly fill those gaps in their agricultural land with home vegetables, flowers, and medicinal plants. They also manage trees or wild plants on their field edges for firewood, shade, fruit, medicines, and other purposes. By asking farmers about these non-crop plants, I was able to better see how commodification of knowledge and different kinds of seed markets were affecting farmer choices.

All organic farmers received the full seed, household demographic, and agrobiodiversity surveys, and I took GPS points for as many organic farmer fields and homes as possible given timing constraints. Because so much of Telangana organic cotton farming on the two kinds of organic farms where I worked is centered around marketing the farmers as much as the cotton product, I accompanied several foreign or non-Telangana business people and NGO officers on tours of organic farms to see how farmers presented themselves to various audiences (myself included). Having introduced my methods, I will now introduce the key social and agricultural institutions that impacted the daily life of the farmers in these areas.

Institutions

As important as the particular geographic and ethnic qualities of my research sites were the institutions that helped villagers make a living. The Rural Development Foundation (RDF), active in Matepalle, Kavrupad, and Ralledapalle, runs schools and professional training programs, to which I have contributed both time and money. RDF eased my access to farmers in many villages both because I could affiliate myself with this well-liked institution and because I could hire English-speaking graduates of the program. RDF's education programs have allowed more young people to move to and work in cities like Hyderabad. Many such farm children then send remittances home to their families, who stay in the villages. Through RDF and their more cosmopolitan children, farmers in these villages also gain exposure to agricultural science and agricultural economics. As these young people learn more about agricultural efficiency and scientific approaches to farming, they encourage their parents to have more faith in agricultural experts. As educated children leave the farms, lean on their parents to modernize, or take over family farms, their experience in RDF's education and empowerment initiatives teaches them to farm differently and to interact with agricultural authorities differently.

In Warangal, the nearest and most important urban center for Kavrupad, Ralledapalle, Srigonda, Orukonda, and Gongapalle farmers, the Archarya N G Ranga Agricultural University (ANGRAU) plant science station educates young scientists in plant breeding, conducts research in new plant strains, and occasionally releases new hybrids and open pollinated varieties (OPVs) of rice, pulses, and cotton. In addition to their scientific research, the station sends extension scientists to nearby villages, especially Orukonda, Guddpead, and Srigonda, promotes various agricultural technologies including Bt cotton, Non pesticide methods (NPM), Integrated pest management (IPM), and optimal growing strategies including fertilizing and plant density. Similarly, researchers at the Indian Council of Agricultural Research (ICAR) and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) study planting strategies, hold agricultural interventions, breed new varieties of crops, and aid in GM development in their missions to breed new and more productive strains of rice and subsistence crops respectively.

ANGRAU, ICAR, and ICRISAT all work with farmers directly to test new interventions and management strategies. Through this collaboration, farmers are instructed in new techniques and their production risk is often underwritten to encourage participation in the program. Participating farmers gain a combination of new skills, new tools, strengthened relationships with scientists who might control access to current or future resources, and social recognition as leading, modern farmers. In addition to these sources, universities also conduct intervention programs. One such program, the E-Digu advice program run through the International Institute of Information Technology, Hyderabad, provides expert electronic advice to participating farmers. While initially popular due to its usefulness, free (grant-funded) services, and seeming conquest of the social gaps between farmers and plant scientists (Stone 2011b), this program has since restructured and diminished in scope.

My work in organic villages was facilitated primarily through an NGO that sponsors non-certified organic farmers (PANTA), which works with Edaggrineelu farmers, the Prakruti Organic and Fair Trade Cotton Intervention program, which works with farmers in the Adilabad district, and an NGO (MATCH) that works with organic, NPM, and *desi*[5] (*Gossypium arboreum* L.) cotton growers. PANTA, working with a Secunderabad-based umbrella organization for sustainable agriculture (SUS), has been instrumental in publicizing Edaggrineelu farmers' efforts since the late 1990s, connecting them to government or international funds, sells their produce in a Secunderabad shop, and has given farmers direct investments in loans and farming equipment.

Prakruti, also based in Secundarabad, works with farmers in Telangana, Orissa, and Maharastra. Prakruti works as a two-tier program. As a development NGO and cooperative, Prakruti secures international funding, applies for grants, partners with national and interantional development initiatives, and promotes education and local entrepreneurship in addition to farming workshops. As a corporation and cooperative, Prakruti organizes farmers into village, district, and state buying and selling groups that partner with other cooperatives and companies to buy and sell certified organic cotton. The corporate arm of Prakruti's work asks that farmers turn profits and sell to organic buyers. The NGO arm of Prakruti's work ensures that grants and government loan programs can help to soften profit imperatives while providing avenues for

[5] *Desi* refers to products that are locally understood to be traditional or otherwise distinctly Indian. In this instance, *desi* cotton signifies varieties of cotton grown before the introduction of hybrids or GM hybrids. More specifically, *desi* cotton is a different botanical species than the fertilizer-intensive hybrids and is native to India. For more on the differences between varieties of cotton, see chapter 3.

more general development. The corporate and development motivations of Prakruti are often synergistic, as organic cotton buyers tend to publicize the ways in which their products contribute to socioeconomic growth, education, modernization, and village livliehoods (broadly defined). Because Prakruti farmers sell certified organic cotton, they must submit to periodic field inspections for organic compliance and they procure seeds almost exclusively through Prakruti and its partner groups.

I worked briefly with Maharastra-based MATCH, an NGO committed to farmer development and empowerment generally. Farmers involved with the programs that I was investigated planted *desi* cotton under a variety of IPM strategies designed to reduce external chemical inputs. As an NGO, MATCH helped farmers find buyers and encouraged farmers to plant certain crops (like lower yielding *desi* cotton), but was not involved directly in sales like PANTA or Prakruti. Rather, MATCH focuses on recruiting and training farmers to participate in development programs as well as alternative agriculture programs. Their funding structure is based in the NGO model of winning grants and connecting farmers to government funds.

This chapter has introduced my methodology and research site. Because of the sampling design, these farmers represent a typical range of variation in GM cotton and rice farmers while the organic villages provide an insight into certified and non-certified organic agriculture. There was a conscious effort in triangulation in this methodological design: use quantitative data from these different surveys or GIS, with statistical power to describe typical farmer decision-making through the sampling strategy as a way of bolstering qualitative data gained through participant observation, focus groups, and interviews. As a scientifically-minded anthropologist, I believe that this approach allows me to tell a more holistic and better supported story of how people learn on these farms. The following chapter discusses the history of cotton and development in

India generally, paying special attention to the contexts in which GM and organic technologies were developed and then translated to the Indian context.

Chapter 3: The Translation of Regulation and Technology from an American to Indian Context.

This chapter discusses the history of cotton and development in India generally, paying special attention to the contexts in which GM and organic cotton technologies were developed and then translated to the Indian context. I begin with cotton cultivation in the mid-1800s to illustrate the deep history of globalized cotton production and the longstanding agricultural links between the United States and India, especially referencing the industrial and postcolonial political economy that established a flow of resources and expertise between these nations (Johnson 2013; Guha 2007; Guha 2008; Perkins 1997). I then compare the spread of organic and GM technologies out of the United States and Europe to show how both are being forwarded as potential sustainable futures in India because of their universal applicability rather than their potential for local variation. This chapter draws on development theory, particularly Escobar (2011), Tsing (2005), and Gupta (1998), and uses Jasanoff's (2005) theory of civic epistemologies to contextualize the Indian regulatory environment. This sets the stage for later discussions of local variations as the seemingly un-changed regulations and technology are encountered by Indian farmers. It also illustrates the botanical, economic, regulatory, and political links that have connected cotton production in the United States and India since the nineteenth century.

Indian agricultural development since 1947 has aimed to cast off former colonial associations with poverty and famine and present India as a global power on par with advanced industrial capitalist nations, especially Britain and the United States, with whom it had close ties through food aid and colonialism (Bagla and Stone 2012; Gupta 1998; Perkins 1997). Noticing a consistent national inferiority complex in the first twenty years after independence, Gupta (1998) calls this sense of underdevelopment and backwardness the condition of postcoloniality. Being a nation of small farmers, India has largely pursued this agenda through an agricultural development that aims to both promote mechanized commodity crop farming and move people from agricultural to industrial sectors. First addressing the problematic linearity of neoliberal development, Gupta contends that development is "Orientalism transformed into a science for action in the contemporary world" (Gupta 1998:37), notably in that it is a progress narrative based in Said's reading of a Hegelian Other/Self dialectic. This gives birth to the endemic sense of underdevelopment that Gupta describes: people must be underdeveloped to be developed, turned into subjects requiring control, dependence, and outside expertise (Kothari 2005; Escobar 2011; Agrawal 2005). Under this definition, agrarian development occurs when farmers can be made to see that their actions are destructive and counterproductive to the goals of the state. Describing the Western development imaginary, Pandian (2011) likens this process to one of maturation, in which Indians cease to be immature children on the world stage and join their former colonial parents.

However, it would be inaccurate to claim that all Indian development has been directed from outside groups pushing capital intensive agriculture on an unwilling populace to wrench them from an agricultural good life into violence and industry. Like Appadurai's (1996) and Tsing's (2005) critiques of a monolithic capitalism, Gupta reminds us that "modernity may have been instituted as a global phenomenon through colonial capitalism, but it was, in the process, resisted, reinvented, and reconfigured in different social and historical locations" (Gupta 1998:9). Denying this anthropological perspective (Shiva 1993), in which global processes are locally reconfigured, ignores the agrarian populist movements that vigorously adopted Green Revolution technology (Robbins 2004) and welcomed a hybrid version of outside influence in an attempt to promote local interests. Farmer field schools recruit and rely on local farming leaders to promote alternative agricultural technology packages as well (Braun and Duveskog 2008; Godtland et al. 2004; Van den Berg and Jiggins 2007). With new technology comes new knowledge, and the authority to claim expertise in that knowledge characterizes the relationships between farmers and developers.

The Social History of Cotton in India

Cotton cultivation is at least 5500 years old in the New World and at least 4300 years old in the Old World (Brubaker, Bourland, and Wendel 1999; Dillehay et al. 2007). The longstanding human interest in *Gossypium* species stems from their unusual epidermal seed hairs, a trait shared by all members of the Gossypieae botanical tribe (Wendel, Brubaker, and Seelanan 2010). Unlike other useful fiber plants such as flax or hemp, which require a time-consuming and relatively labor intensive rotting process called retting to extract economic fiber, cotton fiber can be harvested and processed directly from the plant. While many species of the Gossypieae tribe are referred to as "cotton", that agricultural moniker is technically vague as four distinct species have evolved, been domesticated, and undergone parallel evolution at different times and places to become agricultural cotton. Ancient cultivators, likely in the Indian subcontinent and East Africa or the Levant, domesticated *G. arboreum* L. and *G. herbaceum* L. (Zohary, Hopf, and Weiss 2012). Use of cotton fibers in the Indus valley 8000-6500 years before present (bp) predates domestication, and wild and semi-cultivated cottons were used throughout Asia, the Levant, and North Africa. Although it is unclear if *G. arboreum* L. or *G. herbaceum* L. was domesticated first, the earliest evidence for domestication appears approximately 4300 years bp in the Indus valley region before spreading to the Levant and the circum-Mediterranean region first as a traded fiber commodity and later as a domesticated plant (Brubaker, Bourland, and Wendel 1999; Zohary, Hopf, and Weiss 2012). Both of these Old World cottons are diploid, meaning that they contain two full sets of chromosomes. This differentiates them from New World tetraploid cottons, which contain four sets of chromosomes.

Cotton across the world can be divided into nine genome types. Five to ten million years ago, species of the A genome type developed ribbon-like fibers that would allow early cultivators to spin the threads into yarn. In the New World, the spinnable A genome type crossed with D genome species to create five tetraploid spinnable species. The range of wild, domesticated, and feral *Gossypium* species indicate that New World cottons diversified and were domesticated in tropical regions. *G. barbadense* L. was domesticated in South America West of the Andes while *G. hirsutum* L. was domesticated independently in Mesoamerica (Piperno 1998). Subsequent work has shown that *G. barbadense* L. was likely domesticated in southwestern Ecuador and northwestern Peru, providing a technological basis for a fishing culture 4500-3500 years bp. Because these areas are not domestication centers, cotton's archaeobotanical use suggests that domestication must have been elsewhere before 5500 years bp (Dillehay et al. 2007). Early cotton use was associated with gourds (*Cucurbita pepo* L.) among fishing populations, where cotton fibers were spun into nets while bottle gourds were used as net floats (Piperno 1998).

After millennia of separation, New and Old World cottons were reunited in the 18th century when tetraploid cotton became valuable to the British Empire and its textile industry. To clothe the empire, British entrepreneurs established North American cotton production in the American Southeast that would feed mills in Manchester. North American cotton growers benefited from hardier Mesoamerican AD tetraploid cottons, as well as from the legally enslaved workers that did the actual cotton field management, and outcompeted British production in Australian, Indian, and African cotton-growing regions. Frustrated with American dominance in the cotton market and the political instability of the 19th century United States, British landlords attempted to grow the American variety, *G. barbadense* L. (Guha 2007) in India throughout the 1800s. Small-scale experimentation eventually produced an Indian variety of the new world AD tetraploid *G. hirsutum* L. and opening the door for this species to be grown in 90% of commercial cotton fields (Brubaker, Bourland, and Wendel 1999).

Gandhi would later make cotton a cornerstone of the independence movement by rallying weavers using homelooms, asking them to refuse to sell to British buyers and instead focus on becoming self-sufficient villages (Guha 2007). Such socialist-inspired, self-sufficient village republics ultimately found themselves at odds with the capitalist-tilted modernist industrial vision promised by India's five year plans. This tension resolved itself as Indian agricultural policy in the late 1960s and 1970s shifted decisively toward capital-intensive agriculture under the auspices of the Green Revolution (Perkins 1997). Hybrid cotton breeding efforts began at public research stations in the 1930s to coax heterosis, a desirable response to fertilizer and water inputs in second generation plants. The resulting *G. hirsutum* L. and *G. barbadense* L. blend provided longer staple fiber and greater quantities of cotton bolls. Commercially viable hybrids, a combination of a Gujarat and US cultivar, were released in 1970 from a joint international-national public research effort of the Cotton Research Station Surat in Gujarat State of India, the All India Coordinated Cotton Improvement Project, and the Indian Council of Agricultural Research. By 1995, 36% of cotton area in India was under hybrids, bred to respond to a regimen of chemical fertilizers and water provided by irrigation facilities. These hybrids were developed using facilities at public institutions and provided free of charge to private seed companies for commercialization.

By 1995, about 55% of hybrid seeds were provided by private sector distributors, and private breeders were monitored by the public breeding institutions. Hybrid seed production nearly tripled in the time that hybrids were adopted from 1970-1993, a success that FAO-affiliated Asia-Pacific Association of Agricultural Research Institutions (APAARI) attributes to an organized public research sector, efficient distributors in public and private sectors, market intervention to secure cheap labor, minimum prices on seeds, fertilizer and pesticide subsidies, and incentives for the textile industry to use the new supply and fuel new demand in the global fashion industry (Basu and Paroda 1995). The hybrids, bred to have a high yield of long staple cotton when thoroughly nourished with chemical fertilizers and irrigation, encouraged cotton growers to steadily increase production 1970-1995, albeit at a higher investment in fertilizers and pesticides. By 1998, Indian cotton farmers were applying between 30,000-35,000 metric tons of pesticide (Kranthi 2012), representing as much as 45% of the total pesticide applications in India. This, despite the fact that cotton was cultivated on only 5% of the land (Shetty 2004).

The Development and Regulation of American Cotton Technology in a Transnational Context

India has gained a reputation for famine, poverty, and underdevelopment on the frontier of empire and capitalism. This is ironic, as India has been a testfield for agricultural development including the colonial exportation of raw products across the Indian Ocean (Chaudhuri 1985), the Green Revolution shift to growing input intensive crops (Ross 1998; Perkins 1997), and now the spread of GM crops and organic agriculture. This need for development has ideological roots that reach into the 18th century. Thomas Malthus blamed underdevelopment on India's population and frugal nature, claiming that India "must necessarily be subject to famines. Where a country is so populous in proportion to the means of subsistence that the average produce of it is but barely sufficient to support the lives of the inhabitants, any deficiency from the badness of seasons must be fatal. It is probable that the very frugal manner in which the Gentoos [sic] are in the habit of living contributes in some degree to the famines of Indostan" (Malthus [1798] 1976:53). Thus were bad seasons, rather than exploitative colonial policies to blame for hunger. By 1960 this perception persisted, in the writing of neo-Malthusian Paul Ehrlich and his description of the overpopulation he experienced one stinking hot night in Delhi (Ehrlich 1971).

Cotton agriculture in India has passed through three crucial phases since its commercialization by the East India Company and their attempts to coopt cotton technology to clothe the British Empire (Beckert 2014). The colonial, hybrid, and current genetically modified stages of cotton agriculture have been characterized by a push toward profit, export-based production, foreign technology, and the consolidation of knowledge within off-farm experts. With the loss of the American colonies, the British turned to cotton sources in Africa and India to stoke the fires of the textile industry back in the metropole. Irritated by competition from the genetically more versatile New World varieties, the East India Company hired American planters to teach Indian peasants to farm with new varieties for mass production in 1840, although this production would not gather global market shares until a cotton drought during the American civil war showed that cotton could be grown without slave labor (Beckert 2014). British-Indian cotton strains yielded 25% more, but only with 200% higher cost in production capital. As such their use was a tough sell to Indian laborers. To make matters worse, American and British growers tried to replicate the plantation system with Indian smallholders who lacked the coercive labor of slavery, reliable roads, or storage necessary to maintain the kind of cotton monocultures seen in the United States. However, with the onset of the American civil war, Northern naval blockades interrupted British access to the high-quality fiber. Panicked British farm administrators flooded the Indian market with new seeds, allowing farmers to plant new varieties where the climate suited them. Faced with a confusing array of germplasm, farmers likely mixed local varieties with foreign cultivars to hedge their bets on the new seeds (Guha 2007). By the late 19th century, Indian farmers had developed a successful cultivar of *Gossypium hirsutum* L., a variant of the cotton that now accounts for 90% of our clothing (Brubaker, Bourland, and Wendel 1999). That local strain "flourished" under the name Dharwar-American (Guha 2007:315). That is, viable cotton production had to be discovered through farmer experimentation at the edge of British-American cotton capitalism rather than 19th century development schemes. Only after farmers surreptitiously bred their own varieties within their extant agroecological system did they come to dominate the global textile industry in the late 19th and early 20th century. Indeed, this dominance made Gandhi's Quit India and handloom campaigns so economically and politically successful.

Following independence in 1947, India's long, politically embarrassing, and public struggle with population and famine linked failures in production to failures of national autonomy and agricultural modernity (Bagla and Stone 2012; Perkins 1997). 1950s Indian geopolitics were largely based around pitting Soviet and American development interests against each other (Cullather 2013; Perkins 1997). That is, Soviet and American governments saw large-scale development projects as a competitive field in India, and the Indian government largely encouraged this nonaligned strategy as a means to secure food aid or large infrastructure projects. Seeing an opportunity to woo India away from Soviet influence, the United States sent Green Revolution crop scientists, strains of wheat appropriated from post-war Japanese farmers, machinery, agrochemicals, and subsidized the grain imports that facilitated a massive shift in production (Kloppenburg 2004; Perkins 1997). The collaboration and goodwill inspired by the Green Revolution helped to strengthen ties between the two nations at a time when American geopolitics necessitated friendly relationships through South and Central Asia (Cullather 2013; Guha 2008; Ross 1998). Indian wheat and rice yields climbed, but only after farmers incorporated chemical inputs into their extant views of healthy field ecology and came to terms with a farm budget that saw fertilizer as a commodity distinct from animal production. As with the spread of 19th century cotton cultivars, the implementation of this American technology required local reworking. Farmers came to see the resultant crops as 'weak' (Gupta 1998; Vasavi 1999), in need of pesticide and fertilizer protection. Wealthier farmers disproportionately benefitted from purchasable inputs and new forms of irrigation (Shiva 1993), an inequality that the Indian state was willing to accept if it ended grain imports and famine scares (Perkins 1997; Ross 1998). With respect to cotton, the changing logics of Indian agriculture enabled Indian scientists at public institutions to breed cotton hybrids that responded well to the system of pesticides, fertilizers, and irrigation that farmers adopted throughout the country in the 1960s and 1970s.

19th century agribusiness drew farmers deeper into commodity production through new seeds and production goals, but farmers themselves created the varieties that made this agriculture possible. By the mid-20th century, wealthy farmers integrated themselves into emerging global commodity grain and textile markets, learning to turn state supported cash-cropping based in high debts and high production to their advantage. Poorer farmers did their best to emulate that success, whether that meant using combinations of fertilizer and manure to hedge bets on new seeds, or voting for politicians who would keep input subsidies in place that mitigated the risk of new technology.

By the 1990s some learned to turn the opportunities of the Green Revolution to their advantage, while others grappled with new problems of debt and chemical overuse, including a well-publicized wave of farmer suicide (Galab, Revathi, and Reddy 2009; Gruère and Sengupta 2011; Pandian 2011; Scoones 2006). In rural Telangana, farmers previously engaged in reciprocal finance relations with local landlords and ecological relationships with homemade inputs (Ludden 1999; Gupta 1998; Vasavi 1999) had to navigate landscape of credit, labor, seeds and inputs. Two potential futures gained popularity as solutions to the chemical and capital ills of the Green Revolution. Like their predecessor, both GM crops and organic production aimed to solve agricultural problems through new products: on one hand, a GM hybrid seed that would work within the existing system of chemicals, debts, shops, and plant scientists; on the other, a non-Bt seed that would call upon international green marketing and farmer education.

The use of American GM technology required a regulatory policy that would satisfy countries in the textile commodity chain, international businesses, Green activists, foreign investors, and a poorly educated but democratically active rural population. Sheila Jasanoff (2005) notes in her study of biotechnology regulation that the dynamics of GM regulation depend on a nation's unique civic epistemology. Although both Argentina and Brazil plant more genetically modified crops than India by acreage (Clive James 2010), India serves a more important geopolitical role in the spread and regulation of genetically modified crops in the developing world. South American GM soy farmers tend to own larger farms unrepresentative of small farmers globally, and their images do little to further the argument that GM crops are helping resource poor farmers.

With hundreds of millions of citizens dependent on agriculture (Sainath 2013), India has served as a barometer and trendsetter for both high-tech industry and neoliberal development, especially as regards smallholding farmers (Newell 2003; Scoones 2008; Shiva 1993). India's economic information technology boom, its highly educated science sector, its colonial past, and its extremely active civil society encourage debates on the future of agriculture to occur in a highly public forum (Guha 2008). In the late 1980s, the USA was the only country with a working regulatory framework regarding gene patenting and GM safety, and so those legal decisions were largely adapted to service Indian needs (Heinemann 2012; Newell 2003). Cognizant of the risks of upsetting rural voting blocs, and India's Green NGO sector, Indian policymakers adopted GM regulation in 1989 to obviate potential objections, thirteen years before it would be approved for farmer use.

Because regulation had already been written in the United States, Indian biotechnology policy preceded any actual products. Transgenic material would not be officially imported until 1995 or commercially released until 2002, but regulation began in 1989 with the Rules for the Manufacture/Use/Import/Export and Storage of Hazardous Microorganisms, Genetically Engineered Organisms or Cells through the Notification No. G.S.R.1037(E). The Department of Biotechnology (DBT) wrote the Recombinant DNA Safety Guidelines in 1990 as a preemptive measure anticipating genetic modification and then updated these rules in the 1998. The regulations that initially determined field testing, laboratory conditions, and sales, along with the technology itself, were drawn directly from American policy decisions (Heinemann 2012; Newell 2003). The authority of the American bureaucracy was quickly diluted during the probusiness Reagan administration, especially that of the Environmental Protection Agency. Beholden to different political interests, the Indian bureaucracy retained more power over the spread of GM technology. Their authority to restrict field trials and the spread of GM seeds frustrated multinational industry stakeholders in biotechnology and seed distribution, leading them to form loosely connecting lobbying groups to clarify the industry's needs to the regulators.

The resulting set of complicated rules separated foreign firms, domestic seed companies, regulators, and importers, restricting foreign multinational companies (MNCs) from direct investment or management. To circumvent this, major agricultural producers like Pioneer Hi-Bred, Monsanto, and Syngenta bought subsidiary Indian companies, licensed their technology, and acquired shares in Indian distributors. Especially regarding the sale of genetically modified and hybrid seeds, Indian law is sensitive to a history of peasant exploitation and India has seen some spectacular theft of patented GM seed technology (Jayaraman 2001). DeKalb and Cargill, both American agricultural MNCs, had Indian branches that were acquired by Monsanto, allowing it to import seeds. Monsanto negotiated commercial approval for Bt cotton in 1995 and subsequently purchased a 26 percent share in the Indian company Mayhco to create the Mayhco-Monsanto Biotech India Ltd company in 1998, acquiring not only another established Indian company but a company executive with key government connections (Newell 2003:4).

While GM regulation preceded GM production, India's organic regulation did not coalesce until 2000, sixteen years after the first NGO-sponsored organic conference (Narayanan 2005). As with GM seeds, organic proponents tout organic agriculture's potential to cure India's chemical overuse, reverse nutritional deficiencies, stop poverty, and bring Indian products to new markets (da Costa 2012; Panneerselvam et al. 2012). Seeing that environmental organizations received groundswells of support during GM debates in the 1990s (Schmid 2007), Green policymakers in the United States saw the advantages of positioning themselves as an alternative to genetic modification and the kind of production it represented to consumers (Jasanoff 2005). This opportunistic alliance would lead American regulators to outlaw GMOs from organic production, thus banning them in all subsequent national and international legislation in the name of global consistency. To maintain equivalency with these standards, India's organic guidelines have been adopted directly from USDA protocols, themselves the legal coalescence of more than thirty years of minor regulation by international networks of organic farmers (Conford 2011). As such they deny certification "when use of [GM] products is detected at any stage" (Department of Commerce 2005:92). In aligning themselves with extant American regulation, GM and organic cotton producers became legally opposed and have come to represent two mutually exclusive alternative agricultures because of the ways that farmers use or avoid chemical pesticides and fertilizers in the management of those seeds. This opposition is especially ironic for Bt cotton biotechnologists, some of whom were Rachel Carson enthusiasts who selected Bt specifically because of its longstanding use as a certified organic pesticide in the US (Charles 2001).

Beginning with the colonial period, development seeking to bring India into a modern age has been a specific process of commodification and knowledge consolidation. By the mid-19th century, cotton technology including cultivars suited for Manchester factories, Green revolution state-subsidized fertilizers, pesticides, and hybrid seeds, became successful only after farmers incorporated them into their systematic agricultural knowledge and found support in government assistance (Appadurai 1996; Gupta 1998; Vasavi 1999). For the most recent agrarian crisis of the mid 1990s, brought on by the new logics of globalized cash cropping, states and corporations again targeted farmers for a new round of agrarian development. Because of laws decided in the US and Europe, cotton farmers were asked to choose between a high-tech GM version of development and a low-tech organic version.

Cotton, Development, and Commodification

With regulation in place after 2000, both GM and organic cotton production have continued in India, each receiving billions in public and private support (The Economic Times 2010; The Economic Times 2012). As India's first successfully commercialized GM crop, Bt cotton came to symbolize one possible future of agricultural development there, leading organic agriculture promoters to define themselves as an alternative development. Success in both instances hinges on the regimes' potential to increase income and decrease chemical use. Through scientific studies and public discourse, both regimes have tried to claim this success.

Much maligned and praised, Bt cotton represents many of India's agroenvrionmental paradoxes: the promise of high-tech modernity as well as the threat of eroded past values (Paarlberg 2001; Pearson 2006; Scoones 2008; Shiva 1997; Stone 2002); the influx of new capital and technology amid the danger of increased corporate control (Bagla and Stone 2012; Jasanoff 2005; Newell 2003; Schurman and Munro 2010; Scoones 2006); and the acquisition of new farming methods at the risk of interrupting the farming learning process (Kloppenburg 2004; Pollan 2002; Stone 2007). The model of technological integration and increased external expertise coalesced on American farms through a process that Goodman, Sorj, and Wilkinson (1987) call appropriationism, the discrete commodification of different parts of the farming process by agricultural industries. The farming industry as a whole resists commodification – after all, farmers reproduce seeds, the means of their production (Kloppenburg 2004).

However, a GM hybrid seed, which must be replanted each year to maintain hybrid vigor and satisfy license agreements, presents the latest addition to a steadily commodified investment-intensive agriculture, which encourages the purchase of whole technology packages: the hybrids respond best to a regiment of chemical fertilizers while the GM seeds require specific pesticides for non-target pests, and all of this specific knowledge rests in experts external to the farmer community. “You have to change seeds each year”, Arun, a cotton farmer from Kavrupad who has planted fad seeds nearly every year since 2004 tells me - “the new seeds have the best science”. He is correct: seven different constructs of the Bt gene have now been released, with more coming soon to counter the omnipresent threat of insect resistance. “After three years”, he continues, “the companies become lazy” having won consumer confidence, and so they sell only “duplicate” or fake seeds. The trouble, however, is knowing which new seed to choose. With more than 90% of farmers (The Hindu Business Line 2013) now planting hundreds of brands of GM cotton, non Bt seeds are now virtually impossible to find in the Telangana region.

For organic farmers, commodification comes less through products consumed by farmers than out of the need to conform to international regulations in organic agriculture. The need for regulatory compliance has created a market for NGOs and organic corporations to translate that process to interested farmers. Designed for American farms struggling to stand out to consumers shopping in supermarkets (Guthman 2004), USDA-equivalent certification can be expensive for Indian organic projects. Producers and farmers lack the infrastructure and access to markets that would make organic farming easy and profitable while the benefits of this time-consuming agriculture are perceived to be limited (Eyhorn, Ramakrishnan, and Mäder 2007; Panneerselvam et al. 2012). Additionally, because the government has spent the last 50 years integrating agriculture and industry (Perkins 1997), inertia and farm subsidies are slow to shift from conventional to organic production. Therefore, farmers in India cannot simply decide to grow organic products and market them as such. Rather, organic NGOs play a crucial role in promoting organic agricultural practices in the country because of their ability to commit time and energy required for transition and troubleshooting (Kolanu and Kumar 2003). To take a more critical view, these NGOs devote time and energy to training farmers in a new mode of production, politically engaging them as stakeholders in an international movement that is mutually exclusive with GMOs. The government's lukewarm support for organic agriculture suddenly became a vote of confidence for anti-GM activists, a group that has been described as "based on weak alliances [with national and international anti-globalization and anti-neoliberal groups]; it is dependent on the relationships of key individuals who are often or (some would say) wildly egotistical; and the alternatives being offered are often vague, small-scale and easily ignored" (Scoones 2006:333). With organic production, anti-GM activists made a useful ally.

GM and Organic Cotton as Sustainable Technologies

Even though more than nine out of ten farmers were in the process of sowing GM seed, protests across five states heralded the tenth anniversary of Bt cotton's commercialization in India (Parsai 2012). Protestors have marched continuously since 2002 and continue to march in 2014, as Monsanto is finishing field tests for the next generation of herbicide-resistant Bt cotton. In their discussion of the vitriolic disagreements between organic activists and pro-GM scientists, Schurman and Munro (2010) argue that the public loggerheads stem from an act of interpretation in which activists consciously promoted a different set of meanings than the dominant apolitical pro-science view of GMOs held by policymakers and biologists. In doing so, they sought to disrupt a public predisposition to define technoscientific views of the world as positive. The argument was less scientific and more geared toward mental, moral, social, and intellectual collective action. Recalling Habermas, the authors refer to a lifeworld (Fultner 2011) that describes so-called natural attitudes that define ideas, values, and interaction, generalizing and naturalizing collective experience. While Jasanoff (2005) highlights the economic benefits that flowed to green interests after they sought to make GMOs and organic production mutually exclusive in the USA, she similarly contends that pro- and anti-GM voices often talk past each other, often seeking politically expedient, emotional arguments. VG Ramesh of SUS regularly speaks out against GMOs and sees their introduction in Indian development. Despite 90% adoption of GM cottonseeds, he told me during an interview that he remains convinced that:

> GM at this point and time is not a viable technology. There are biosafety issues with it. So, [other development agencies and I] don't agree on that. It's not about whether [organic groups] are certified or they don't certify. If somebody wants to put [GM technology] in organic agriculture it doesn't matter for us, as long as the biosafety issues associated with GMO are resolved, that's all. That's what I would say.
>
> Andrew: Concerns about gene escape, cross contamination, these things?
>
> Ramesh: No actually gene escape is one problem. You look at the impacts on soil health, impacts on people's health, it's huge. See the process of gene transfer itself is not yet precise. So in the gene transfer process, knowledge is not precise. Obviously it will have biosafety implications. This is one part of the story. The second problem is [GM seeds] have patents already. It has legal controls on it so obviously it gives monopoly rights for some, so we are opposed to that as well. Both need to be addressed. So as long as both are not addressed we are not for it. The issue is not about, we are not opposing it because it is GM. It is not because certification agencies do not accept [GM seeds]. So tomorrow certification agencies may accept [GMOs], what does it matter? The problem remains.

Ramesh has no interest in working with GM developers, not only because GMOs are incompatible with organic regulatory structures but because he disagrees with the heavily corporatized kind of agriculture that genetic modification represents. Such development is, for him, inherently dangerous from a legal and ecological point of view.

For his part, G. Shankar of Monsanto India has grown frustrated with what he sees as an unscientific criticism of his work. Rumors of animals dying from eating GM crops persist despite any conclusive evidence of Bt's harm and Bt's longstanding use as an organic pesticide. The opposition has led Shankar to a similarly aggressive stance against organic agriculture:

> I'll tell you, I think we have to be a little more real in life. I think that people confuse organic and inorganic in many ways. To me, field crops have to be looked at from a different perspective. As I said now soil is important. First you have to understand whether soil is good in organic content or not. Right? And in fact I believe in integrating [some organic methods]…The moment [many farmers] see the pest, they don't have a good knowledge, and then I would say that organic methods can work with us in a nicer way and say we will work on integrated pest management, integrated useful management. I would be very open to those ideas. In fact you know our experiments in agronomy, because we educate, we tell farmers and give as much of organic sources as are available. The challenge is: so you talk about sucking pests. Suppose sucking pests are a problem. Is there a good sucking pesticide available which is of organic sorts? The answer is no. Is it available in sufficient quantities, is it affordable. My feeling is that the hardcore organic lobby believes farmers are fooled which I think they are not. If anything works on their farm they will adopt it…If you have to think of improving only organic cotton you need 20 tons of farmyard manure per year. Do we know what we are talking here? So where are you going to bring that much of organic manure…how many cows do we need, who's going to, if we get food for them so they can produce so much of organic matter. They have to be, you know, a little more practical about such things.

Each high level manager is casting the other side as unwilling to listen to reason, whether it be biosafety concerns or the practical realities of farming. Despite, or perhaps because of, Bt cotton's massive adoption, GM and organic farming systems must present themselves as alternative visions of India's agriculture.

International and domestic NGOs have begun promoting organic agriculture as an alternative development resonating with the paradoxes above. However, many of the same issues relating to an uncertain knowledge base can affect organic farmers as well. In aligning themselves with international organic suppliers and markets, Indian farmers must learn organic standards and production practices. This often takes the form of farmer field schools, development initiatives designed to teach farmers to use input un-intensive methods. These farmer field schools take place under the onus of foreign agricultural development, and share root assumptions about underdeveloped subjects, the superiority of outsider knowledge, and the creation of new experts with new technologies, broadly defined (Escobar 2011; Pandian 2011).

Viewed as technologies, genetically modified crops and organic production offer potential solutions to South Asia's agricultural woes: chemical treadmills, famine, suicide, poverty, and development. Ultimately both forms of production seek a measure of socioecological sustainability, but our understanding of that term has shifted toward one based in flexible, resilient relationships between people and the systems they manage (Berkes 2012; Leslie and McCabe 2013), it has become clear that the sustainability of environmental systems hinges on the skill required to apply that management.

Unlike the health benefits promised to consumers of organic produce, the consumption of organic cotton rests solely on perceived benefits for growers and the environment. As such, organic cotton producers in India market farmer field schools have an explicit mission to improve farmer empowerment, a decidedly moral mission that also seeks to build self-confidence, problem-solving skills, and encourage empowerment (Chetna Organic 2013; Franz and Hassler 2010). Low input technology field schools do not commodify knowledge in the way that Bt cotton commodifies pest resistance through a purchasable seed. Instead, the international NGO network and neoliberal organizations that fund these projects rely on success narratives, morally "transformed" (Duveskog, Friss-Hansen, and Taylor 2011) farmers, and triumphant photographs for donor money or added value products. On the production side, farmers must use particular organic inputs or methods that conform to organic regulations. On the consumption side, the farmers themselves become commodities sold to donors or ethical buyers wishing to invest in alternative development projects that generate new, developed subjects (Franz and Hassler 2010).

Beginning with the colonial period through the Green Revolution and contemporary GM seeds, development seeking to bring India into a modern age has been a specific process of commodification and knowledge consolidation. However, these processes have never been smooth or one-sided. Thanks to a flood of postcolonial scholarship on the consequences of global modernist development we know that commodities are always reinterpreted and reappropriated by consumers (Appadurai 1996), be they goods or technological systems. The seemingly inevitable spread of this development is slowed by local friction that causes it to be reproduced in a culturally acceptable form or generates an informal economy to accommodate those who do not benefit (Tsing 2005). On 19th century Indian cotton farms farmers likely mixed local varieties with the British cultivars to hedge their bets (Guha 2007), a practice still seen when farmers buy a swath of different kinds of GM seeds to insure themselves against seed failure. In fact it was only after the colonial cotton project was declared a failure and oversight decreased that Indian farmers developed the successful Indian cross of *Gossypium hirsutum* x *Gossypium barbadense*, that led Indian cotton farmers to dominate the global cotton market (Wendel, Brubaker, and Seelanan 2010). The same hedging and adaptation was widely prevalent as the modernist, market-capitalist goals of the Green Revolution were promoted by the Indian and American governments. Early GM farmers likely stole seeds from test fields to trial the technology on their own terms (Herring 2007). Even on current certified organic farms, Indian cotton farmers diversify their fields with Bt cotton to reduce the risk of solely cultivating an unknown crop (Makita 2012). Engaged with the Green Revolution, organic development, GM cotton agriculture, farmers have been adding their own trial, hedging their bets, and translating the new demands of markets and regulations.

This chapter has examined the social, botanical, and historical context of cotton in the Telangana region and in India generally. Since the colonial period, cotton law and technology has largely been translated from an American to Indian context. The most recent iteration of this translation manifests in the push to create a sustainable, resilient agriculture through foreign GM or organic technology. Farmers and policymakers are in the process of deciding if this will manifest as high-tech GMOs or low-tech organic agriculture, which have been mutually opposed by laws prohibiting cross-contamination, as well as by the rhetoric of GM and organic promoters who promote their own products by calling their opponents dangerous, ignorant, and impractical. Thus is India experimenting with two legally and socially exclusive forms of sustainable agricultural technology – GM crops engineered to lower pesticide sprays and organic crops designed to reduce overall chemical inputs.

I argue that skill, farmer knowledge and the ability to perform that knowledge in the dynamic farm environment, is the true determinant of sustainability. The next chapter overviews perspectives on skill, its importance to socio-environmental resilience, and the ways that social and environmental learning have been privileged in theoretical discussions of the anthropology of knowledge. My claim that farmers use what Stone (2016) terms a combination of environmental, social, and didactic learning sets up the empirical discussions that follow, which center around the observation that farmers draw unevenly on these sources of information as a function of their social status, wealth, prowess as farmers, or the resources offered to them by institutions.

Chapter 4: Divergent Agricultural Regimes as Tools to Explore the Creation and Adaptation of Agricultural Knowledge

This dissertation investigates the creation and adaptation of agricultural knowledge under three different agricultural regimes: GM cotton, rice, and organic cotton. Each regime carries a particular set of incentives, risks, and avenues for success. Each reward structure is also dominated by a different social politics, a shifting labyrinth of those with knowledge and influence and those with uncertainty and anxiety. In this dissertation I focus particularly on seed choices. Therefore knowledge, management, and reward structure are bound up in the different commodity forms that these seeds take on. In turn, the social constraints under which farmers generate knowledge, ranging from caste to debt, are tied to the seeds.

Varyingly a commodity to be consumed and a means of production, seeds place a particularly interesting set of demands on Telangana farmer knowledge. In the introduction to *The Social Life of Things*, Appadurai observes: "Commodities represent very complex social forms and distributions of knowledge" (Appadurai 1988:41). The vast historical interconnections of regulation, production, consumption, and genetics along cotton's commodity chain were discussed in the previous chapter. Moving forward I am concerned with the ways in which complex social forms and distributions of knowledge manifest as farmers navigate GM cotton seeds, rice seeds, and organic cotton seeds. If commodities have life histories, careers, or biographies in a meaningful sense as Appadurai and later Kopytoff suggest in *The Social Life of Things*, then the distribution of knowledge at each stage can reveal how learning is related to the social politics and reward structures of different versions in agriculture.

Before moving on to a review of innovation theory and the anthropology of knowledge as they relate to Telangana farmers, I would like to situate this current study of the social politics of commodified seed knowledge within work by Stone (2007; 2016), Kloppenburg (2004), and Fitzgerald (2003). Numerous researchers have documented how farmers in the 20th century experienced unforeseen upheaval as they traded household labor and knowledge for expert guidance and purchasable inputs including chemicals, machines, and seeds (Brookfield 2001; Goodman, Sorj, and Wilkinson 1987; Magdoff, Foster, and Buttel 2000; Netting 1993; Pollan 2006; Stoll 2002). Of these, Stone, Kloppenburg, and Fitzgerald pay special attention to the new risks and rewards that arose as a result of these new relationships to land, inputs, and labor. The transnational pathways that would bring Indian farmers new seeds and new reasons to grow them redefined the parameters for agricultural success. In doing so, they necessarily changed the content of what farmers needed to learn in order to be successful.

For sociologist Jack Kloppenburg (2004), this process began with the seeds themselves. Kloppenburg traces the routes by which 19th century American military officers transferred plant genetic resources from the tropics to land-grant universities. Improved plant varieties and later hybrids were easier for farmers to buy than breed themselves, leading to the ultimate privatization and sale of this publicly developed seed technology. In a process repeated throughout the Green Revolution, Kloppenburg shows how state breeders around the world created plant varieties that would respond well to particular methods of harvesting and capital-intensive plant management. In dissociating that management knowledge from the farmer and associating it with a purchasable commodity, Kloppenburg and others (Magdoff, Foster, and Buttel 2000) argue that agribusiness used new seeds to encourage farmers to buy a set of associated technology. When that wasn't enough, state and private breeders incentivized production directly through free services, gave out national awards, flooded markets with seed varieties, and subsidized production of commodity crops.

Fitzgerald (1993; 2003) draws attention to the changes in farm management that accompanied these new technology packages. American farmers buying hybrid maize seeds became alienated and deskilled as their specialized crop knowledge was subdivided and appropriated by agribusiness managers. Excluded from labor studies that described this deskilling process in industry (Braverman 1998) because farmers and their skills were nonhomogeneous, Fitzgerald argues that farmers nonetheless abandoned a complicated producer skillset in favor of buying a consistent product. When saving seed, farmers had to 'read' corn, translating values of color, texture, or taste into agronomic qualities of yield, quality, insect resistance, or other values. But with the development of higher-yielding hybrid seeds and, crucially, new credit demands that encouraged farmers to plant cash crops above all else, farmers abandoned this knowledge. The new system defined success through a seed more aligned with scientific modernity and higher yields. The scale and sophisticated monitoring of these breeding programs excluded farmers from the seed production process. Soon, farmers were belittled by crop science experts consolidating knowledge in the corporate sector and trying to "beat the farmer at his own game" of seed saving through hybrids that debuted in the 1930s. Fitzgerald (1993) cites one 1936 catalog, in which Funk Bros. Seeds Co. advised farmers not to worry if they didn't know which hybrid strain to order: Funk would supply the hybrid best adapted to their land. This is the industrial logic or ideal applied to agriculture (Fitzgerald 2003), where farmers adopted a matrix of interrelated innovations managed by people external to the farming household.

Where Kloppenburg and Fitzgerald describe the conditions under which farmers relinquish knowledge of seeds and their management, Stone (2007) picks up this thread in describing agricultural deskilling among Indian farmer planting GM cotton. Cotton agriculture, already dominated by hybrid seeds, was further removed from farmer knowledge with widespread planting of GM cotton. Stone argued that this disconnect was not because the seeds were integrated with commodified technology packages. This had already happened with the hybrid market in which the seeds were unrecognizable and inconsistent because of their rapidly changing genetic makeup. GM cotton, sold in India as an unrecognizable, inconsistent, and rapidly changing product, exacerbated this existing problem. For Kloppenburg, farmers learned to define success as planting the modernist seeds. For Fitzgerald, this industrial logic encouraged farmers to enter into an agricultural system wherein they became obligate consumers of interrelated technologies, none of which farmers themselves learned to produce. Stone shows one possible endgame of this deskilling process, in which Indian cotton farmers unable to differentiate cotton seeds instead over-rely on the choices of their neighbors, leading to transient seed 'fads'. This dissertation is more concerned with how farmers make decisions given the reward structures that they *do* have at their disposal with GM cotton, organic cotton, and rice.

Each author traces the rippling effects of seed commodification and agricultural commodification generally to show how changes in products make possible changes in the larger agricultural system. Seeds are emblematic not only of creeping appropriationism (Goodman, Sorj, and Wilkinson 1987), in which discrete elements of the farm production process like population improvement through seed saving are transformed into industrial activities like commercial seed breeding, but of the entire process by which farmers make agricultural decisions. In changing the ways that farmers receive the seeds that are fundamental to their production, different agricultural regimes change the conditions under which farmers generate knowledge and value success. Yet because farmers manage multiple crops, the same farmers are often simultaneously building wildly different skillsets. The next section examines how anthropological theory has examined the process by which farmers develop knowledge, arguing that a focus on social and environmental learning has unfairly obscured the institutional avenues that define farmer options and determine the conditions for farmer success.

Environmental, Social, and Didactic Learning on the Farm

Stone (2016) places scholarship on agricultural knowledge within innovation theory, the study of how people adopt and adapt new technology. Initial studies in the 1940s such as Ryan and Gross' (1943) research on hybrid maize adoption sought to model and explain the social factors that contributed to farmer seed decisions. The authors also noted that commercial interests and extension offices aggressively promoted the corn. Early adopters planted hybrid corn tentatively, planting it in experimental plots, while later adopters planted larger percentages of their holdings with the seed. Although farmers heard about the new seed first from salesmen, they were more strongly influenced by neighbors who bragged about successful seasons. Social, environmental, and didactic forces were all at work in influencing farmer decisions. While not described in a unified way, work on the role of institutions, personal experience, and social emulation in the creation of knowledge laid the foundation for the study of the diffusion of innovations (Rogers 2003), a socioeconomic model that explained how new technologies succeeded or failed to enter our lives.

While research in the field at first sought to synthesize tripartite learning, Stone argues that research in the diffusion of technology and the creation of knowledge generally has become divided by discipline. Economists, modeling decisions to take place within a more or less free marketplace, have emphasized choice, evaluation, and trialing. By emphasizing environmental learning, economists conclude that the diffusion of innovations is the result of superior technology winning out. Anthropologists and social theorists emphasized social ties as a means of denaturalizing the spread of technologies. Even when examining Ryan and Gross' hybrid maize data, economists (Bikhchandani, Hirshleifer, and Welch 1998; Griliches 1957) argued that rate at which farmers adopted hybrid seeds reflected not a building social consensus but a graduated spread of information about the seed's inherent effectiveness and profitability. Griliches and Bikhchandani et al. both acknowledge the early influence of socially important actors, but argue that the characteristic S-curve[6] describing this and other adoptions ultimately stems from individuals analyzing their options and making choices that optimize economic variables, particularly profitability and yield. Looking at the same data, Kloppenburg and Fitzgerald attributed this spread to the influence of creeping modernism and industrial logic in farming. Influential people and ideas, they argued, not a cost/benefit analysis born of farmer trials, led to hybrid maize's popularity.

Although they emphasize different factors in the learning process, a wide range of disciplines have recognized elements in what Stone (2016) calls a tripartite learning process: environmental, social, and didactic or institutionalized learning. In environmental learning, people trial or otherwise evaluate technology and base their decisions on an analysis of the results of their efforts. In some instances this is similar to an economic rationalism that weighs costs and benefits with each decision (Griliches 1957; Griliches 1980; Herring and Rao 2012), but Ingold (2011) has shown that environmental learning can also be seen when a person learns through self-discovery or trial and error from first-hand experience – even when a person is shown something, Ingold argues, they must discover it for themselves. In social learning, people defer to the choices of others and ultimately copy or emulate their choices on social criteria

[6] When modeled as a percentage of adopters, this S-shaped pattern shows minor initial growth as the earliest adopters use an innovation, a period of rapid adoption wherein most people jump on the trend, and then a minor late adoption as the final stragglers join what has become mainstream.

(Boyd and Richerson 1988). This can lead to transmission biases including prestige and conformist biases, in which information carries extra weight because it comes from a socially prestigious person or because it is especially popular. In didactic learning, institutions or people exhibit active instruction carried out on the basis of interests external to the farm, often under the auspices of a larger group. Didactic information also carries prestige and conformist biases that are rooted in the institutional or figurehead authority and the community's response to that authority. Each of these will be deconstructed in turn, but it is easy to see how each of these three perspectives might bleed into the others. Environmental concerns, like how a seed performed relative to other seeds, impact social concerns, such as how that performance might be tested against the purported success of a different seed (Stone, Flachs, and Diepenbrock 2014). If a didactic program makes any headway in a village, we would expect that the instructors carry some social weight, like the domineering early agricultural scientists described by Kloppenburg and Fitzgerald. In anthropology, we further recognize that no social or environmental knowledge takes place in a vacuum – institutions structure what knowledge or technology is available for farmers to learn and copy in the first place.

Recent work has emphasized ways in which both emulation and first-hand experience contribute to farmer decision-making. For those trained in economics, the absence of reliable environmental feedback can help explain why various kinds of social learning are fragile, such as faddish consumer behavior (Bikhchandani, Hirshleifer, and Welch 1992; Bikhchandani, Hirshleifer, and Welch 1998); they can show the ways in which social learning can ease the burden of learning many new things at once, as with Tepic et al.'s (2012) study of the ways that Dutch hog farmers learned from one another's' experiences with state regulation and new production technologies; and they can highlight information networks that spread useful environmental knowledge, like those used by Ghanaian pineapple farmers making fertilizer decisions (Conley and Udry 2010). Those trained to recognize social influence have used environmental learning to describe how people learn socially, as observed useful innovations do not diffuse because the innovative farmers are of low social status (Henrich 2001; Tripp 2006); when conformist bias, or following the crowd, can maintain economic choices that provide suboptimal returns in the name of keeping step with popular choices (Richerson and Boyd 2008); when people assume that experts can better navigate a difficult or confusing market than they can, despite negative environmental feedback (Iyengar, Huberman, and Jang 2004). The farmers in this study, as with farmers participating in a globalized economy anywhere, needed to try to stay abreast of changes in their own fields, the myriad changes in the confusing seed market, and changes in neighbor fields. Like farmers everywhere, they succeeded in some ways and failed in others. Relying exclusively on one's own field in a landscape with a wide range of variable input choices that could not be trialed by any individual makes no sense in the economic model of the rational evaluator. Moreover, it would be absurd in the ethnographic model of the socially connected subject beholden to cultural conformist biases based around social status.

In addition to the problem of conformist bias generally and in the specific case of Indian farmer decision-making, Telangana cotton and rice farmers face an additional problem of data analysis. As shown by my analysis in chapter five, chapter six, and chapter seven, these farmers are not collecting or analyzing high-resolution data. Their recollections of seed choices and inputs may be hazy at best, while the actual differences they observe are barely even noticeable by the analyzing anthropologist looking for significant p values. Such variation is almost certainly lost in the cotton field. Social theories of environmental and social learning, as well as empirical study (Stone 2007; Stone, Flachs, and Diepenbrock 2014), suggest that influence of authoritative voices, including large farmers, shop owners, scientists, and successful farmers, are far more important in a dataset with no clear environmental trends.

This understanding of knowledge suggests that social and environmental context depends on the commodity in question, as different products, technologies, or forms of knowledge with different culturally ascribed meanings and didactic forces pushing them will allow different kinds of environmental responses. Farmers' ability to evaluate new forms of cotton or rice seeds, as in this study, would thus depend on how those crops are made locally meaningful. Cotton, a cash crop sold as a commodity and produced only for the market, brings a totally different set of anxieties about knowledge and production than rice, destined for saved stores and cooking pots as well as markets. During farmer focus groups, I asked what new seeds farmers had heard about. Farmers might shout out dozens of names, all of which were new seeds and thus relied on social knowledge rather than any first-hand information. One farmer explained, "If it is a new seed, we'll remember the seed name and plant it. And if we get good yield they plant the same next year. Year after year the seed will reveal itself. But if it decreases then another new one is produced." There is no way to keep track of seeds or predict new ones. In cotton, farmers must wait and watch. Even if farmers were able to stay abreast of all the possible changes in cotton seed brands, black market sales and misleading marketing would still stymie their attempts at experimentation. The farmer continued, "the seeds is very good in the advertisements, but all the companies sell fake seeds. When we get them, we're not even getting our investment back!"

Learning and the local meaning of the commodity are thus intertwined. As Dove (2011) describes, differences in crops determined for market and those that serve a more complicated cultural purpose as food or security reflect profound differences in the social worlds of these commodities: Dove describes Indonesian smallholders who conceived life as a cycle of exchange and regrowth within the social and ecological community. The rubber cash crop killed a part of this exchange and harmed the land itself (Dove 2011:171), even threatening to destroy the spirit of swidden rice. Telangana farmers do not see cotton land as a threat to their rice. The threat in this thesis refers to the variable destruction of knowledge because farmers are not rewarded for practicing or developing a balanced set of agroecological knowledge. Rather than see cotton as a direct threat, farmers see it in a more banal, neoliberalized form: the branded commodity, something outside of their control.

The Importance of Environmental Learning in Building Knowledge

Emphasizing any particular element of Stone's (2016) tripartite system risks ignoring the influences of the others. Yet because it is the most personalized manifestation of learning, or at least because it is managed at the household level at which farming labor and knowledge are organized, environmental learning is a linchpin for farmer knowledge. As has long been recognized, people who do things know things. Theorists of smallholder agriculture, notably Netting (1993), Brookfield (2001), Conklin (1961), and Richards (1985) maintain that it is the active practice of knowledge and its capacity to be change that allows smallholding farmers to be successful in a mixed market-subsistence economy. As the commodification of that knowledge has been piecemeal in agriculture, farmers in Telangana have been left with a mosaic knowledge: usable and reliable in contexts where environmental learning is rewarded, and dependent on social or didactic learning in other contexts.

Farmers risk losing their knowledge base and treating their fundamental means of production as commodities when they have no avenues to or reasons for generating knowledge through environmental learning. Both element of this process are important: The avenues by which farmers generate knowledge, namely trialing new technology, must provide some pathway toward a reward if that knowledge is to be put to good use. Farmers who cannot use knowledge about particular seed performances to inform their seed choices or who develop knowledge that does not help them strike a fair price in the market might be learning plenty, but they are not learning the skills that reward their farming regimes. Thus are both the products and the social worlds that they inhabit important criterion for generating and adapting knowledge.

The failure to spread useful technology can be illustrated through the slow diffusion of some organic cotton programs. Numerous economic models have suggested the superiority of organic cultivation, especially for resource-poor, small cotton farmers (Eyhorn 2007; Forster et al. 2013; Makita 2012; Prashanth, Reddy, and Rao 2013; Panneerselvam et al. 2012). In each case, researchers extol the clear benefits in profit margins and quality of life, and show that organic cotton has the potential to yield similarly to GM cotton strains. The problem, they lament, is the farmers. Farmers are suspicious of the schemes, do not want to learn new methods, do not want to abandon their personal cultivation knowledge, and do not want to join a kind of agricultural that will separate them from other farmers. The challenge lies in enabling poor farmers to believe that organic production is worth the poor yields of the production period, the development of new skills, and the "emotional" ownership of their products and their regulation (Eyhorn 2007:17). For these researchers, the problem is not one of environmental learning so much as didactic success. Farmers in these studies did not want to abandon known agricultural logic in favor of a new technique, in part, as each study recognizes, because they did not fully trust organic programs to follow through with their promises.

With so much attention toward the interactions between individual/household environmental learning and the social relationships that give that knowledge meaning, it is easy to see how didactic learning gets lost in the mix. Following Stone, I call this kind of learning didactic in the sense that it refers to active instruction that occurs under the auspices of a larger institution with a moral or political purpose. Stone (2016) outlines three kinds of didactic situations, corporate, state, and NGO that fall under this rubric. In the research for this project, I observed that various didactic programs sponsored by the Indian government, local shops, foreign NGOs, local NGOs, universities, and corporations engendered four different kinds of explicit farmer performances in response. Farmer performances and professed transformations are discussed at length in chapter eight and chapter nine.

As with the prestige bias in social learning, didactic learning appeals to an authority: follow the advice of particular experts because of their social status. In India, the colonial and Green Revolution didactic instructors had the benefits of race, wealth, foreign influence, caste, and the backing of influential leaders including *zamindars* and members of the civil service (Beckert 2014; Guha 2008; Gupta 1998; Vasavi 1999). This legacy continues in the current didactic landscape of foreign development programs, Indian NGOs, state sponsorships, corporate sponsorships, and university programs. As so often happens, the earliest adopters are those who people look to because they are expected to do well in the first place (Rogers 2003; Stone and Flachs 2014). By obscuring the institutions that set the conditions for environmental or social learning, this anthropology of knowledge misses the institutional context in which the conditions for success, risk, and reward are set. Didactic learning, at least initially, determines the future course of social and environmental learning for new technologies.

Didactic learning here serves as an initial push, in which those recruited farmers are meant to field test expert methodology, generate improvements (environmental learning), and then use their social influence to convince others to follow suit with the method (social learning). The long-term stability of this attempt to influence farmer decision-making is a serious problem for programs that rely heavily on didactic learning over an extended period, such as organic programs requiring frequent outsider visits and regulatory compliance. The ways in which organic farmers and program managers troubleshoot this issue is discussed in chapter seven. Such didactic programs make a concerted effort to construct facts, not in service of shifting a larger scientific discourse (Latour 1986; Latour 2010) but to sway local opinions of farmers in shops, newspapers, media interviews, and casual shop interactions where individual and household farmer decisions are made.

Building Theory in the Anthropology of Knowledge From GM Cotton Farmers, Rice Farmers, and Organic Farmers

Stone's work (2007; 2016) has stressed the dangers of over-relying on any particular kind of learning in agricultural systems. In his study of GM cotton farmers 2002-2012 (Stone, Flachs, and Diepenbrock 2014), Stone has shown how environmental learning became fundamentally destabilized as farmers over-relied on social emulation. In this study, I consider GM cotton, rice, and organic agriculture regimes as three exemplars of the different ways that Telangana smallholders build tripartite knowledge. In each system, there are elements of environmental, social, and didactic learning. Yet because of the demands for profitability in an uncertain market, reliability in a limited market, and compliance in a market where choice is removed, farmers' choices for GM cotton, rice, and organic agriculture respectively permit them to generate and use varying kinds of knowledge.

Studies promoting the early success of GM cotton in India have been attacked on the basis of poor scientific rigor, namely in choosing groups of farmers that one would have expected to do well in the first place: those farmers who were wealthiest, more adventurous, had more land, and had higher yields in general (Crost et al. 2007; Gruère and Sun 2012; Stone 2011a). Thus, their work represents a selection bias and is therefore a poor predictor of GM crop yields in India generally, despite the claims of pro-GM agricultural economists (Qaim 2009). Kathage and Qaim (2012), attempted to refute such insinuations in a paper that used a fixed effects analysis to even out farmer selection bias between 2002-2008. Kathage and Qaim claimed that Bt seeds caused a 24% increase in cotton yield and a 50% percent gain in cotton profit, while allowing that the cost of production has increased 18%. Too little too late, claimed Stone (2012), who argued that Bt cotton success narratives had already been established by initially poor scientific practice of selection bias, extrapolating long-term trends from short-term studies, and a cultivation bias in which farmers lavished extra care on the more expensive and supposedly transformative seeds. This lowered the bar in the peer-review process, allowing pro-GM studies, already inclined to be exciting or controversial and thus attractive to academic journals, to flow through publication as the studies cited each other and established a circular credibility. Thus was the institution of scientific inquiry and reporting compromised in its analysis of GM cotton.

Postmodernism and relativism at its worst, replied critics (Herring and Rao 2012; Herring 2013), leading to an ongoing debate through the widely read Indian journal *Economic and Political Weekly*. Regardless of triumph narratives and initially biased studies, each study continues to build a scientific consensus that Bt cotton improves lives and crop yields, and the presumption that such research stems from a loose alliance between GM manufacturers and scientists "are strong claims, even by the standards of conspiracy theories" (Herring 2013:63). Herring cites *Merchants of Doubt* (Oreskes and Conway 2011), an exposé on the manufacture of doubt in tobacco and climate science, to argue that science works on empirical consensus by qualified experts and accuses Stone of mongering doubt in a settled field. Citing Latour's *Promises of Constructivism* (Latour 2003), Herring asks if people like Stone would have scientists consider facts to be socially constructed modernist fiction (Herring 2013:63). Stone's (2013) rebuttal, in which he cites years of ethnographic fieldwork to establish credibility as a non-postmodern scientist, falls short of questioning facticity itself, but rather the empirical basis of the triumph narrative when so many factors in the analysis are simplifications and abstractions constructed within the confines of the research project.

Ultimately, the argument over the success or failure of GM crops in India is a different question from Stone's criticisms of the skilling process. Herring and Rao do not engage with this theoretical element of Stone's arguments on deskilling, except to use skill as a stand-in for adoption, yields, and profitability (Herring and Rao 2012:52). As shown by the wealth of theory complicating farmers' abilities to trial and Stone's argument that Bt cotton is particularly difficult to trial, there is no reason to expect that environmental learning is a salient factor in Indian farmer Bt cotton choices. However, this was a testable question: how do farmers balance and fail to balance various forms of learning in their GM cotton choices? As I show in the following chapter, farmers do indeed conduct the kind of evaluations that Herring and Rao, and others, claim. In the mid 2000s, didactic programs were also in place from universities and corporate actors asking farmers to grow Bt cotton as part of an IPM system. The didactics worked better than seed companies could have hoped: news of Bt cotton's success spread and other farmers raced to copy one another. Furthermore, pesticide use appeared to fall dramatically at first, when Bt cotton was used as an IPM technology (Kranthi 2012). However, more farmers appeared to know less about particular seeds. The resulting seed fads can be seen as a distinctive feature of cotton's particular commodity form in Telangana. Building on Stone's model of agricultural deskilling the bewildering cotton seed market leads to deskilled farmers in part because the initial didactic pushes, wherein farmers first learned about GM seeds, led to a commodity market rather than a new and usable skillset. Farmers continue to trial, but that environmental learning does not inform the following season's choices because of what theorists (Henrich 2001; Boyd and Richerson 1988; Richerson and Boyd 2008; Boyd, Richerson, and Henrich 2011) might term maladaptive conformist bias. The didactic modernization program that was GM seeds succeeded in attracting droves of farmers and likely raised yields somewhat (Crost et al. 2007; Herring and Rao 2012; Stone 2011a; Kathage and Qaim 2012), but within the specific social world of cotton cash cropping, this is not the same thing as skill. Skill must be based within environmental learning as it is practice-based. Although celebrated in the village as trendsetters, even the wealthiest, early adopting, largest, highest status farmers appear to have no means to develop skill. In this case, the initial didactic learning that characterizes new agricultural technologies left farmers no way to wade through the seed market.

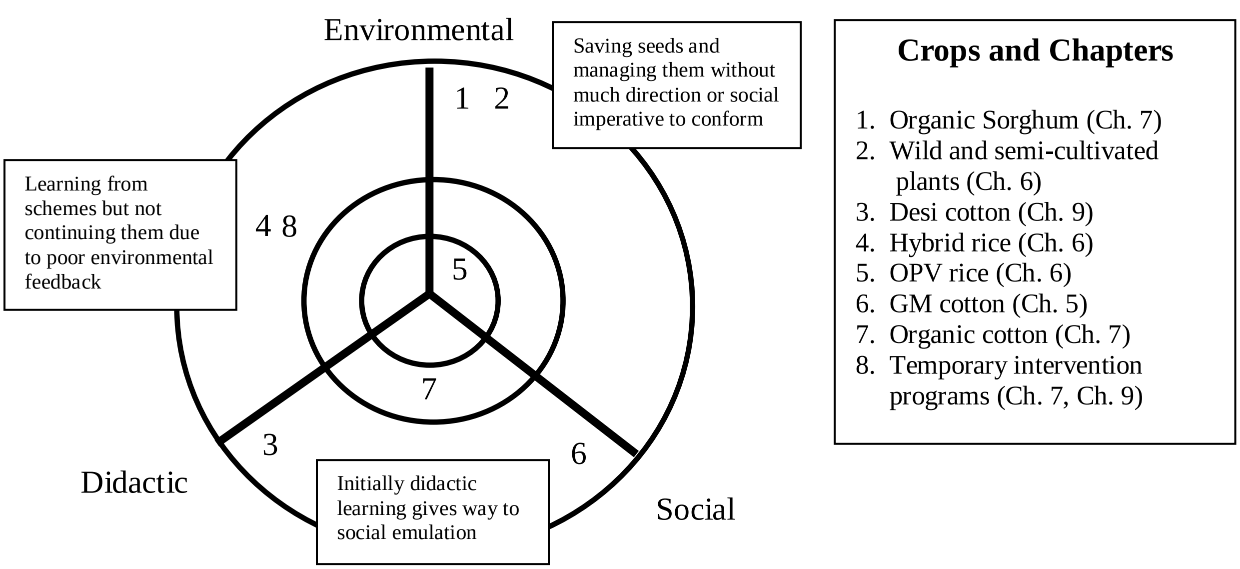
When the same farmers grow rice, they employ a more certain kind of knowledge to manage the ecological demands of their crop and to make a profit. The rice seed market is fundamentally different than cotton, giving rise to more favorable conditions for environmental learning. Looking to diffusion and innovation during the spread of high-yielding varieties (HYVs) of rice and wheat during the Green Revolution, Munshi (2004) argued that a heterogeneity of rice farming strategies and local agroecological properties inhibited social learning so crucical to cotton agriculture in the early 2000s. Green revolution rice growers found it difficult to control for all the variables that would have allowed them to learn from their neighbors' choices. Munshi concludes that farmers tended to experiment more with HYV rice than wheat, in part to compensate for this missing social information. Telangana farmers are not necessarily lacking socially-transmitted information to inform their rice seed choices. My analysis shows that farmers widely agree on important agronomic indicators of rice success and compare successes and failures with new varieties across fields. They just do not allow this to serve as their only or overwhelming source of information. Rice seeds, because they can be saved, because farmers and buyers seek the same qualities for growing and selling this crop, because the choices are far fewer and more consistent, and because farmers are not necessarily trying to maximize their yields and profits above all other considerations, are better suited to a balanced interaction between environmental, social, and didactic learning.

As I detail in chapter six, Farmers gain a tactile knowledge by touching seeds throughout their crop cycles. Like the early American corn growers described by Fitzgerald (1993), they can judge their rice seed (in part) by if it 'looks' correct. Farmers 2012-2014 overwhelmingly planted the same handful of Open Pollinated Variety (OPV) rice seeds year after year, giving them a far surer environmental knowledge base from which to make future decisions. These decisions were reinforced both by the social knowledge of seeing other farmers plant and succeed with the same seeds and the didactic knowledge wherein the slowly introduced new seeds carried locally specific attributes clearly labelled to solve problems that farmers mentioned in complaints to plant science stations. Some farmers were lured by the didactic and then social promise of a high yield with relatively untested hybrid breeding seeds locally called male/female seeds. Others were not. That farmers did not abandon their crops in droves to take up the latest opportunity for quick cash, as they often do with new cotton seeds, speaks to the greater cultural calculus that takes place for farmer rice choices. Rice seed can be bought or sold but it is not reducible to the profit end-game as easily as cotton seed. Other farmers watched their adopting neighbors closely, and saw them fail or grow frustrated with hybrids. When the didactic push to convert farmers to these new seeds failed, social learning did not have a chance to supplant the strong environmental knowledge base that characterizes rice. However, as indicated by the 18% of rice choices captured by hybrid seeds 2012-2014, farmers remain open to new rice technology. For now, elements of social, didactic, and environmental learning are balanced here.

On organic farms, didactic learning must transition from initial education to environmental and social learning relatively quickly. To stay profitable, most farmers try to strike a balance whereby they can maintain a positive relationship with their sponsoring organic program and still farm in a way that allows them to generate and adapt knowledge. Farmers take up a variety of learning strategies on the certified and uncertified organic farms that I visited. Didactic farming education groups often rely on these adapting farmers as spokespeople to convince other farmers to follow suit, creating new and fascinating systems of obligation between farmers and organic field agents. This kind of didactic learning is designed to give way to social learning. Environmental learning persists for others who work to locally adapt pest control methods to the availability of trees, water, and electricity in the villages. These farmers are then asked to teach modified versions of organic methods in their own words the rest of the village. Didactic learning here is combined with first-hand environmental knowledge, and the resulting information is spread to others through social learning. Other farmers refuse to adopt organic methods in total, keeping a diverse skillset in which they work with didactic programs to some extent and ignore them on different fields. For many farmers, the didactic instruction of organic agriculture is ignored in favor of social learning because the programs are uninteresting and time-consuming. Preferring to learn from others in village who attend planning meetings and distribute seeds, these farmers treat organic knowledge and inputs as commodities brought to them at a discounted price. As with many GM cotton farmers, the technology's environmental superiority is less meaningful than the social weight of the people promoting it.

Importantly, all farmers are generating and adapting all of these kinds of knowledge because they all grow a variety of crops in a variety of agricultural regimes that permit different kinds of learning. GM cotton farmers grow rice, almost all farmers grow heirloom vegetables and flowers in their fields, and several organic farmers grow GM cotton, organic cotton, and rice. The knowledge they create and adapt is a function not of their own capabilities but of the social and didactic conditions under which they can use these different seed commodities (**Figure 4.1**).

Figure 4.1: Crops Discussed in this Thesis and their Relationship to Tripartite Learning



In this diagram, environmental, didactic, and social learning represent the different influences by which farmers make decisions. Numbers represent crops discussed in this thesis. The closer numbers are to the lines, the more dominant that kind of learning in the reward structure of that crop's agriculture, as determined by the analysis in the forthcoming chapters. Circles indicate relative distance from the center, in which all three kinds of learning would be used. For example, farmers use primarily environmental and social learning to make decisions about OPV rice, and more occasionally make use of didactic knowledge. Farmer more consistently favor social learning for GM cotton decisions and environmental learning for organic sorghum and wild or semi-cultivated plants. In general, the most heavily didactic or heavily social kinds of learning remove farmers the farthest from environmental learning. This places them at the greatest risk for deskilling.

Conclusion

This chapter has served to underscore that environmental, social, and didactic learning are never really separate. These three types of learning define the conditions by which farmers generate knowledge and thus heavily influence farmer decision-making. When different kinds of learning are emphasized due to differing agricultural regimes, farmers are able to build certain kinds of information. Without these incentives in place, farmers are forced to turn their attention to other elements of the production process in the hopes of surviving in this quickly-changing agrarian economy. Knowledge of seed choice, for example may be faddish and transient, but the knowledge that one should conform to neighbors and shop suggestions as the best way to navigate this uncertainty is widespread. Unfortunately in that example, abandoning seed knowledge to others in favor of a conformist buying pattern has far more benefits for predatory seed companies than for farmers.

When knowledge becomes relegated to the few, or tied to a didactic effort, knowledge itself becomes a commodity. It becomes a thing with a social life and as such it must be recognized and culturally marked. It is for this reason that I argue that commodity theory is a helpful tool for bridging disciplinary divides in this study of the anthropology of knowledge on Telangana farms. Both a means of production and a consumed commodity, different kinds of seeds are culturally marked as different things for different farmers. As such, these seeds or rather the agricultural regimes in which they grown allow farmers to create different kinds of knowledge and thus make different kinds of decisions. As shown by anthropological work that emphasizes informant opinions and performance, a wide range of commodities come with cultural baggage that influences the knowledge that users can create and share: fertilizers and pesticides had to be reimagined in India as part of an Ayurvedic understanding of plant health (Vasavi 1999; Gupta 1998); workers invoked spirits when confronted with the cold working relationships of foreign-owned firms in Bolivia (Taussig 1983) or Malaysia (Ong 2010); McDonalds had to adapt its menu and marketing to local consumers to become profitable in East Asia (Watson 2006); and in Telangana, India, genetically modified seeds intended to improve environmental sustainability exacerbate problems in the farmer learning process (Stone, Flachs, and Diepenbrock 2014). Seed markets, commodity buyers, shops, didactic programs, universities, state and corporate programs, the village hierarchy of social status, and the uses to which farmers put the crops provide the cultural context in which farmers make seed decisions. Just as the commodity is produced, consumed, and reimagined in each stage, farmers use these different crops to produce different kinds of knowledge relevant to markets, seed stores, and visitor performances. Knowledge itself is a function of each crop’s and each regime’s needs.

This chapter has placed Stone's (2016) tripartite theory of farmer learning in conversation with social theories of knowledge and ethnographic examples that illustrate social, environmental, and didactic learning to argue that: (1) environmental learning is especially crucial to the ways in which farmers develop local knowledge and (2) farmer knowledge reflects the kinds of opportunities they have to learn about seeds and apply that knowledge as growers and sellers. In practice, farmers draw unevenly on these sources of information as a function of their social status, wealth, prowess as farmers, or the resources offered to them by institutions. The next three chapters discuss in detail how farmers make decisions about GM cotton, rice, and organic agriculture by drawing on quantitative and ethnographic data related to the tripartite learning process. In each kind of agricultural regime, farmer seed-buying and agricultural management reflects the possibilities for learning and success offered by the balances of environmental learning, social learning, and didactic learning.

Chapter 5: The Social Politics of the Breakdown in Environmental Learning Among GM Cotton Farmers

The ability to build agricultural knowledge, or skill, is a balancing act between different kinds of learning. In a balanced tripartite system of agricultural learning (Stone 2016), to over-rely on any particular kind of information is to shut out new opportunities, say, ignoring the potential of a new extension service or turning a blind eye to a neighbor who uses an innovative new method. In this chapter I draw on the experiences of GM cotton farmers to show that environmental learning is especially crucial to the skilling process. When farmers step back from environmental learning to rely on information that is not based in their own experience, they additionally relinquish a monopoly on knowledge and its execution. The conditions by which environmental knowledge is created thus take on a social dimension as farmers try to learn about cotton seeds and their management. Because knowledge is socially mediated on Telangana cotton farms, the most vulnerable small, poor, tribal, and low-caste farmers can become the most abused by the uncertainty in this predatory cotton seed capitalism.

This chapter argues that farmers do not have an equal or free choice in their cotton seed decisions and that farmers do not herd toward particular Bt cotton seeds because the faddishly popular seeds are superior. At the level of individual farms as well as the level of the village as a whole, no seeds perform demonstrably better than others. In fact, no farmers be they richer, more experienced with the seeds, or older benefitted from yield advantages with cotton seeds generally, yield advantages from fad seeds, or yield advantages from with related management strategies. Importantly, the lack of observable advantages with these seeds does *not* arise because farmers fail to conduct experiments designed to generate environmental knowledge. Many farmers, especially larger farmers with more land available for trialing, plant multiple seeds and evaluate the results. However, none of this seems to provide dividends during the harvest and farmers appear to be starting each new season with no environmentally-based planting rationale.

Telangana cotton farms are unlikely places to trial for a number of reasons. First, the village is not a random, controlled test site. Large farmers control more of the available village seed real estate, meaning that other farmers who observe their neighbors' results and see what seeds they should plant in the coming season are more likely to see the results of larger farmers' choices than smaller farmers' choices. While experiencing no yield advantages, these larger farmers enjoy social advantages, such as friendlier access to seed sellers or extension agents in addition to a modicum of agricultural advantages that allows them to better manage the uncertain seed market. Furthermore many farmers buy seeds from black market traders or through larger neighbors, lacking specific information about these seeds even in the best of circumstances. Larger farmers may play a role in helping to drive seed fads, but this is not evidence of any seed's superiority so much as evidence that farmer choices in the context of poor environmental feedback, unclear government policies, market saturation, and socially driven agricultural decision making are dynamic and fragile. Farmers are not learning which seeds are best, quite the opposite: they are learning that they should not trust their own results.

Among conventional farmers, GM cotton seed choice is a high-investment, high-payout gambit. As such, profit margins and yield are paramount. Almost all farmers planted multiple seed brands so that they could evaluate the results. However, in most cases, these trials proved to be meaningless. Rumor of a spectacular yield in a neighbor's farm or one seen on television is enough to cause a farmer to disregard their own experience and rush to plant the new seed, even if the farmer had no personal experience with it – one farmer abandoned a seed he had planted for at least five years because he “heard from a friend that [fad seed] Jadoo gave farmers in [a nearby town] high yields”. Additionally, the recall rate of seeds from year to year is very poor. As most farmers keep neither receipts nor seed packets after seeds germinate, last year’s choice is often forgotten by the time that farmers buy new seeds. They may evaluate differences in seeds but these differences are often ignored or misremembered when farmers visit the shop. Add to this the larger context of seed uncertainty and a social imperative to defer to visiting experts, shops, and the advice of large landlords, and cotton choice becomes ironically constrained in a marketplace defined by too many choices.

Figure 5.1: Cotton Seeds by Percentage of Households Buying a Particularly Popular Brand[7]

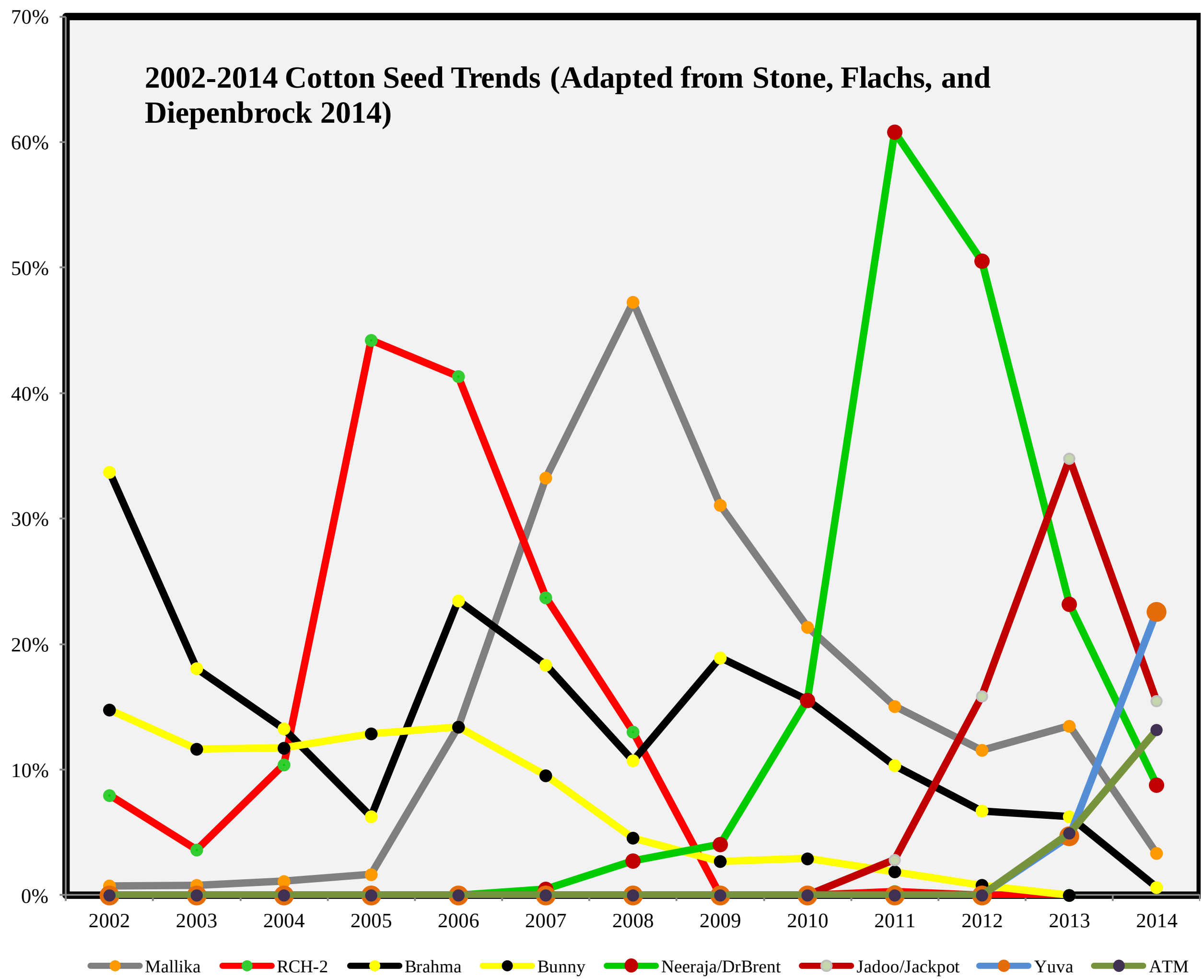


Figure 5.1 shows the transient, faddish popularity of seed brands in the Warangal District. Lucky brands enjoy, on average, a year of ascension, a year of popularity, and a year of decline. As a whole, farmers are switching brands so quickly that they do not have time to evaluate given seed brands on their environmental merits in the farmers' own field. This graph shows the severity of the fads and the depth of their reach – in 2011, for example, more than 60% of cotton farmers bought part of the package of Dr. Brent and Neeraja offered by the Mahyco Seed Company, only to abandon it in droves by 2013. The resulting uncertainty after

[7] For a complete discussion of these fads and their periodicity see Stone, Flachs, and Diepenbrock (2014)

fad years leaves knowledge vacuums where the farmers are adrift and unsure which seed banner to gather under. This instability, illustrated as a series of peaks and valleys, reflects an interruption of the skilling process. Stone (2007) blamed this interruption on an overreliance on social emulation. By 2014, this pattern was the new normal boom and bust of cotton farming. For such farmers, knowledge becomes more fragile in the face of sudden unexpected changes. A fundamental characteristic of transient fads (Bikhchandani, Hirshleifer, and Welch 1992), this instability leads farmers to over-rely on experts in the village or behind the desk of a seed shop because the farmers themselves are not the stewards of local agricultural knowledge. A brief summary of a seed craze in 2012 illustrates the precariousness of this situation for all farmers.

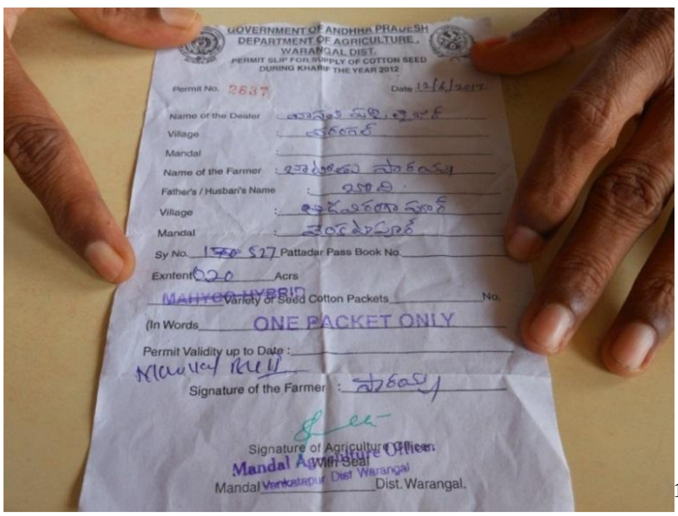
The Effects of Uncertainty in the 2012 Seed Market

The government of Andhra Pradesh was not oblivious to faddish spikes in seed demand as these drove up investment costs for an already expensive crop that threatens to place farming constituents in debt. In 2007, the populist state chief minister YSR Reddy led a campaign to cap license fees for Bt technology in Andhra Pradesh. Recognizing that a state-endorsed added cost would be better than the rampant theft of their technology, Monsanto reduced the technology fee for Bt genes to Rs 150 ($3), down from Rs 1250 ($25) (The Hindu 2007). This protected farmers buying Bt seeds in shops from the price demanded by a free market, although seed costs have increased more than Rs 300 ($6) since this policy was put in place. In 2012, a spike in demand for three seeds[8] from the Maharastra Hybrid Seed Company (Mahyco) and one seed[9] from the Nuzivedu seed company led to shortages across Telanagana. The seed companies that serviced Telangana, and particularly the Warangal district, had failed to allot enough seeds to

[8] Neeraja (MRC 7201-BGII), Dr. Brent (MRC 7347-BGII), Kanak (MRC 7351-BGII). The trade name of the seed brand is listed first with the hybrid number given in parentheses.
[9] Mallika (Bt-NCS 207).

meet projected demand. The maximum retail price assigned by the state precluded shops from legally raising prices in response, and so farmers who could afford to do so rushed to Warangal city shops to pre-order seeds.

To control demand and temper high market prices during this period of seed scarcity, the state government distributed permits that guaranteed a given seed's price and availability based on shop pre-orders. Permits, distributed to farmers from their local government office through a lottery system, specified a particular shop, seed brand, price, and the number of packets an individual could purchase.



[10]

A Warangal seed permit for one packet of a Mahyco Hybrid.

In this way, one farmer got one permit for one package at one shop. Prices were (theoretically) controlled and sales of those four seeds without a permit were criminalized. Had Warangal district farmers and seed sellers followed these restrictions exactly, farmers who did not receive a permit or did not receive sufficient quantities of the seeds they desired would, like any rational economic actor, simply switch to another brand. This solution was, at best, naïve of the destabilized learning that led farmers to stampede for specific seeds in the first place, as well as

[10] All images taken by Andrew Flachs unless otherwise specified.

their willingness to circumvent the law. At worst, the perceived authority given to the seeds by government involvement sustained the fads for those seeds and made those popular seeds seem even more elusive and desirable.

"The farmers are like ants", observed one Warangal shop owner drily when I asked why the farmers were seizing upon the fad seeds. By capping the cost for these seeds far below what farmers were willing to pay, the state government unintentionally created a black market to serve those farmers without seed permits. Prices varied, but farmers could expect to pay at least twice the shop rate (Rs 2000 or $40) for black market seeds that should cost Rs 930 ($18.60) . In 2012, the Mahyco company distributed about 6,000,000 packets[11] to the state of Andhra Pradesh, leaving a deficit of 400,000. These missing packets arrived from other districts and from the neighboring state of Maharastra, where seed supply better matched seed demand (Rao 2012; The New Indian Express 2012). Shop owners and farmers offered several theories on the supply and demand mismatch: seed growers had stolen the crop and sold it to a rival company; Mahyco was keeping the demand high and supply low in the Telangana region to encourage smuggling and extract bribes; agreements between the state government and Mahyco limited supply to increase demand for the Mahyco products in coming years.

Whatever the root cause, the permit system proved to be frustrating for seed shops that abided by government rules: permits kept the price artificially low, which benefited farmers lucky enough to receive them, but the system also punished shop owners who made a slim profit on the most popular seeds and then watched as black market brokers capitalized on the supply vacuum. Preordering Mahyco seeds in 2012 was expensive and required shop owners to take out loans with high interest rates – the "more we invest in Mahyco, the more we lose" scoffed a

[11] One seed packet is sufficient to plant one acre of cotton at a "double lining" in which plants and rows are equally spaced, usually about 90cm by 90cm. Since 2013, many farmers have begun "single lining", in which the spacing is tighter and two packets are required to plant an acre. Spacing will be discussed later in this chapter.

Warangal shop owner in an interview. To mitigate this loss, some shop owners charged farmers extra 'transportation costs' that mysteriously disappeared from receipts. In more extreme cases shop owners sold the black market seeds themselves, although agriculture officers made enough highly publicized arrests to make shop owners wary of such obvious lawbreaking (The Hindu 2012). Frustrated with repeated seed shortages, black markets, and reports of unreliable seeds, Telangana's northern neighbor, Maharastra, first accused Mahyco of selling directly to the black market (Wadke 2012) and then ultimately banned Mahyco seeds for several months.

The government chooses seeds for price guarantee permits based on their projected popularity, but in 2012 this became a vicious cycle where people demanded popular seeds, the government limited their distribution with a permit scheme, and the resultant scarcity then caused those seeds to become even more popular. Farmers in the Warangal villages where I worked dealt with this new wrench in their learning process in different ways. "Those with political connections and money take the permits and the cheaper Mahyco seeds. Others see them [taking the seeds] and want them, and pay high prices for them, and then continue to plant Dr. Brent and Neeraja even after the plants fail because the shops sell out," complained Ralledapalle *thanda* farmer Yakub. Certainly knowledge of the scarcity, personal relationships with the office distributors, and the money necessary to guarantee preorders played a role in who was given permits and who was left to scramble in the aftermath. In Gongapalle and Kavrupad, dominated by farmers belonging to the caste system, farmers tended to accept this scarcity and the resulting unequal permit distribution. Other farmers followed a more communitarian strategy in which they pooled their subsidized seeds to distribute them equally. In Srigonda, this redistribution fell along the lines of a farming cooperative while closely related tribal families in the *thanda*s near Srigonda and Ralledapalle distributed seeds amongst relatives. In the absence of law-abiding shops or kinship ties, farmers turned to unscrupulous brokers, who were restricted by neither legal nor familial requirements to supply a good seed at a fair price. In turning to brokers, farmers showed that they were so desperate to get a chance at fad seeds that they would risk buying a more expensive seed with no guarantee of its veracity.

Broker strategies varied between communities with differing levels of access to information or transportation. The most obvious and least difficult way to buy black market seeds was to wait until another farmer mentioned an opportunity and go along. This required little special effort on the part of the farmer, but required that the farmer possessed the right access to transportation or social connections. A more proactive approach involved speaking directly to shop owners, who sometimes sold black market seeds and offered to connect farmers with brokers. Others pooled their resources with friends and neighbors to send delegates to other states or other districts where they could find the fad seeds. The community paid for their smuggler's transportation and expenses as well as a modest markup for the seeds in exchange for a guarantee for their favorite brands. This could be dicey – if border police apprehended the buyer as he crossed into Andhra Pradesh the person would be on their own, receiving no help from those who sent him. Seed brokers contended with police checkpoints on Andhra Pradesh's Maharastra border, leading entreprenurial smugglers to hide seeds in containers for non-permit brands, bribe border guards, or even hide seed packets in headscarves and turbans. After hastily assuring me that he only brought small, practically-legal, amounts across the border, one broker reminded me that the high risk entailed a high reward: "he who does not get caught will be king", he smirked. This optimism was tempered by uncertainty. Farmers rarely knew brokers' names, could not find them after the sale, and even bought the seeds in secret to avoid being discovered by police.

In addition to the necessarily higher investment cost of purchasing their favorite seeds in the black market, farmers stressed two risks when buying seeds from brokers: seed resellers give no bill of sale and they sometimes sell spurious or "duplicate" (Telugu = *nakkali*) seeds. The problem of receipts is significant as receipts give cotton farmers a modicum of security. Should the seeds fail to germinate, as is especially likely in times of drought or unpredictable weather, they can present their bill of sale to agricultural officers who may then launch an investigation and eventually compensate farmers for lost revenue. Farmers with receipts at least have a chance to recoup their losses. When farmers buy at extra cost in the black market, they waive their right to this recourse and brokers are difficult to track down by the time that cotton germinates. This places farmers with the least access to desirable seeds at the most risk for being cheated. Poor farmers ask wealthier neighbors with connections in other states to bring seeds; they ask the higher caste neighbors on whose farms they provide labor to buy seeds; farmers living in tribal *thandas* without regular bus access are especially likely to see these travelling brokers and to buy their more convenient but less reliable seeds. The reverse, that brokers would target high caste households or that high caste farmers would ask their laborers to pick up seeds is unthinkable in this social landscape.

It would be misleading to blame GM seeds themselves for causing farmer uncertainty. However, the pitfalls of the subsidy system illustrate how devotion to fad seeds exacerbates underlying risk and complicates existing problems with environmental learning as regards seed choices – Warangal district farmers in 2012 bought unlabeled seeds from untrustworthy people for exorbitant prices even though the farmers had never before planted 30% of the seeds they purchased. This extreme reliance on social learning, the emulation of others as opposed to environmental learning from first-hand experience, characterizes Warangal farmers as an aggregate over the last ten years (Stone 2007; Stone, Flachs, and Diepenbrock 2014). Having established that farmers go to extreme lengths to get particular seeds, an economist may protest that this is because the fads seeds are demonstrably better. However, as I will show, the fad seeds do not give any better yields for any group of farmers. Furthermore, an overload of seed options, deceptive labelling, and poor environmental information about the spread of available seeds prevented farmers from making truly free choices when they bought seeds. Given the exhaustive array of seed choices and the uninformed way in which they are purchased, seed choices are often more a social choice than an economic choice. The next section discusses the initial uncertainty in the GM cotton market and the dramatic rise in GM seed brands over the last decade.

Uncertainty in the Seed Market During the Introduction of GM Cotton

In 2001, as Indian regulators scrutinized stands of Bt cotton in test plots, tragedy struck Indian cotton farmers in the form of a sweeping bollworm infestation. Yet one hybrid brand, Navbharat-151, mysteriously resisted the bollworms and saved harvests for farmers in the northern state of Gujarat. Ensuing investigations revealed that the Navbharat company had developed and sold the seed, containing Monsanto's Bt gene and conferring resistance to the bollworms, for at least three years (Roy, Herring, and Geisler 2007; Jayaraman 2001; Shah 2005). Controversy surrounding the Navbharat-151's well-publicized success led Gujarati seed producers (with the understandable exception of Navbharat) to file a suit with environmental regulators and uproot existing Navbharat cottons on the grounds of genetic contamination. The stopgap was shortlived, and in the face of state legalization, further hesitancy from the central government would have been "pointless" (Roy, Herring, and Geisler 2007:160). In March

2002, India opened its doors to three provisionally approved Bt hybrid cotton seeds. The years immediately preceding and following GM legalization were characterized by the rampant theft of experimental transgenic seeds and the cottage industry that arose to surreptitiously breed and sell them, what Herring (2007) and others term Robin-Hooding. Opportunistic gins, especially in Gujarat, saved and illegally sold GM seeds, creating a market defined by a few trusted corporate varieties and many more spurious stealth seeds, a kind of agrarian "anarcho-capitalism" (Herring 2007:135) where counterfeiters and legal distributors vied for market shares. The same market saturation is now experienced among Chinese smallholders, where shakedown streets and spurious seed sellers trip over themselves to recruit buyers (Wang and Fok 2014). Fueled by a mismatch between demand and access in both countries, black market vendors' opportunism compounds the already present confusion over what GM cotton is and does. Citing an official within the Indian Genetic Engineering Approval Committee (GEAC), Herring (2007) suggested that the early uncertainty might give way to a greater reliance on and trust in corporate seed breeders (although he argues that a 'Goldilocks' solution exists where regulation and stealth seeds coexist might be more likely). The enthusiasm with which farmers adopted Bt cotton by 2008 signified different things to international agribusiness, the NGO apparatus, and the farmers themselves. Agribusiness tried to frame legal GM cotton as an technological fix to curb suicide and yield failure; NGOs warned against the specter of neoliberalism and corporate colonialism; cotton farmers heard of yield increases at a time when researchers report that the seeds were poorly understood and when a limited number of GM seeds were available to a limited number of farmers (Herring 2007; Plewis 2014; Pearson 2006; Qaim and Zilberman 2003; Stone 2007; Stone 2002). By 2013, 92% of cotton planted across India contained Bt genes (Cotton Corporation of India Ltd. 2014)

In 2002, Indian farmers had the option of buying three legal GM seeds alongside a cottage industry of illegal Bt seeds based in Gujarat. By 2012, the illegally produced Gujarati Navbharat 151 had likely disappeared and farmers in the Warangal district appeared to prefer to buy one of the 1,000 available corporate seeds, seeing seeds sold by brokers or in unlabeled packages as an option of last resort. Branded, commercially produced hybrids are far more popular, triggering the fads, scarcities, and permits. Facing seed shortages, Warangal cotton growers in 2012 turned to riskier, smuggled, unlabeled, seeds sold by brokers only after they failed to obtain those seeds legally and always with the hope that the seed they purchased was the brand it claimed to be. Fraudulent, black-market stealth seeds were railed against by farmers and corporate interests alike while newspapers carried ads teaching farmers to spot fakes.

A 2014 advertisement in a local paper from Ajeet seeds Ltd. shows farmers how to spot spurious seed packages

The stealth market of homemade seeds that persists in China was not a factor in seed purchases in Telangana 2012-2014. More important is the explosion of legal seed brands, many of which are duplicitously labeled, contain the same hybrid constructs, and may be mislabeled or misleadingly sold by seed brokers. GM seeds contain one of seven gene constructs, but the vast majority (**Table 5.1**) of these seeds contain the gene construct MON 15985 as of 2013, a second generation, Bt-expressing cry gene construct licensed by Monsanto under the trade name

Bollgard II ®. MON 15985 represents the second generation of GM cotton in India, expressing two different versions of the insecticidal Cry proteins found in *Bacillus thuringiensis*. Although I spoke with some Maharastran farmers in 2014 who planted illegally obtained F1 research hybrids of the as-yet unreleased next generation of GM cotton, which stacks traits for Bt and resistance to Monsanto's herbicide Roundup ®, the corporate market has little to fear from spurious and viciously hated *nakkali* (fake) seeds. *Nakkali* is a broad category and can refer to seeds labelled as the wrong brand; seeds containing no Bt gene intended for field refugia; seeds that fail to germinate; or even in one instance seeds that were not cotton. In India, yields have increased, farmers have adopted Bt seeds in droves, and seeds have diversified into more than 1000 brand names in 2014. Of these, individual shops will likely carry several hundred seed brands in any given year. From a strictly economic rationalist perspective, such brand diversity and heavy competition should be a boon for farmers, cutting costs and raising the quality of the

Table 5.1: Gene Constructs in Indian GM Cotton Seeds 2002-2011

Gene Construct	**2002**	**2004**	**2005**	**2007**	**2008**	**2009**	**2010**	**2011**	**Grand Total**
(cry 1Ab -cry 1Ac) "FM Cry 1A" G				3	10	32	12	7	64
cry 1 Ab+Cry 1 Ac			1						1
cry 1 Ab+Cry 1C			1						1
Cry1C (Event S9124)					2				2
Fusion-Bt/GFM Cry 1A								3	3
MON 15985			7	10	53	130	142	256	598
Mon 531	3	1	38	50	43	53	34	8	230
Grand Total	**3**	**1**	**47**	**63**	**108**	**215**	**188**	**274**	**899**

Numbers reflect the number of seeds approved by GEAC per specific genetic modification. By 2011 most new seeds contained Monsanto's 15985 event, the second generation Bt technology Bollgard II®. No new constructs have been approved since 2012. Source: (GEAC 2012).

seed products. As illustrated by the seed fads (**Figure 5.1**), however, this is not the case (Stone, Flachs, and Diepenbrock 2014). First, the Indian seed market is restricted by maximum retail prices, meaning that individual seed brands cannot distinguish themselves on the basis of price points and companies have few incentives to develop and sell superior products. Because no GM cotton seeds could be sold for more than Rs 930 during 2012-2014, all seeds with Bollgard II® technology were sold for Rs 930. Second, farmers surveyed for this dissertation and in the literature (Herring 2007; Qaim 2009; Stone and Flachs 2014) knew and continue to know relatively little about what GM cotton is and does beyond a vague knowledge that it may be resistant to some pests. Nearly fourteen percent of the farmers surveyed in 2014 indicated either that the cotton they purchased that year was not Bt or that they did not know for sure if it was Bt (**Table 5.2**), although this information is clearly labeled on every seed packet. No non-Bt seeds were sold at the Warangal shops surveyed 2012-2014 with exception of a cooperative shop in Srigonda, which sold no seeds to farmers in the sample. Shop owners reported that such seeds would not be popular among farmers. Even farmers who know what Bt is and what it does could be fooled by the numerous seeds with different brand names but identical hybrid numbers – the Nuziveedu company, which sells seeds under subsidiary companies including Fortune

Table 5.2: Farmer Knowledge of Bt in 2014 Sample (n = 463) as a Percentage of the Whole

	BG II	Bioseed	Double Bt	Yes	Bt II	DNK	No	Total
Is this seed Bt?	1.9	0.2	0.4	82.5	1.1	9.9	3.9	100%

Highlighted cells represent that for 9.9% (46) and 3.9% (18) of the 463 seed choices made by 194 farmers in 2014, farmers answered that they did not know (DNK) if the seed was Bt or that it was not a Bt seed. Source: Flachs Farmer Survey 2014.

Hybrid Seeds, Asian Agri Genetics, and Dhanlaxmi Crop Science, is especially guilty of selling the same NCS-207 Mallika hybrid and NCS-108 Sunny hybrid type under multiple trade names.

Left: seed packet front side. Right: seed packet back side. A Warangal seed and chemical shop pulls down the different brands of the NCS-108 Sunny hybrid type that he sells in his shop.

Monsanto supply chain lead C. Rajesh explains how these companies strategize:

> There is a particular hybrid code that you register in the government annals. You need sales permission for each of the hybrids, right? So there is a particular hybrid code that you register with the government regulatory system for a sales license. It's also [assigned as part of] a testing program in government universities just like anywhere else in the world, and you use a specific hybrid code. It is possible in India to market the same hybrid code, same basic thing, under different brand names…Why would you want to do it? You may want to do it partly because the Indian farmer is looking for diversification. You know, even if your product is very, very good. The theory at least doing the rounds is that you know the Indian farmer never wants to put one hybrid, all eggs into one basket. Even if he's got a tiny farm of under five acres, even if it is five acres or ten acres, you take that you split it up between two, three, or four hybrids. That is one part of the equation. The other part of the equation is there's also trade in between. There's the retailer, and in the retail channel, if a particular product becomes very popular…in the same road there can be twenty, thirty shops all selling the same product. As the demand of a particular product becomes high, people start to compete with each other…now in that process you could quickly start dwindling profit and then after having done that, themselves they would hate that product because they would say, 'hey, I'm not making any money out of it, I'm not going to push this anymore.'

Rajesh was quick to note that this is not Monsanto's strategy, as Monsanto makes money from GM licenses, not from seeds sold by other companies. Observing multiple hybrids marketed under different trade names, Stone (2007) argued that the destabilization of the local farmer knowledge base began with the introduction of hybrid seeds and has intensified with GM hybrids. As available seed brands jumped from four to 51 in 2005 and continued to grow every year since (**Table 5.1**), what manifested first as village-wide fads had become more intense, district-wide fads by 2012, a phenomenon Stone calls herding behavior (Stone, Flachs, and Diepenbrock 2014).

Stone's (2007; 2011a; 2011b; 2014) work in Andhra Pradesh has described this uncertainty as agricultural deskilling, after Braverman’s (1998) description of industrial alienation. On the factory floor, workers become deskilled when knowledge is concentrated in the hands of managers who use that monopoly of knowledge to control the production process. In agriculture, knowledge and the learning process determine how farmers manage their fields as both producers and consumers. Stone’s evidence for deskilling, the cotton fad patterns, was largely circumstantial and aggregated seed choice data from several villages. Indian farmers had aggressively adopted the new technology of Bt cotton, especially after 2005, but no individual seed has maintained more than a passing supremacy over its competitors. This led him to argue that deskilling had increased alongside an increase in reliance on social emulation, not because of uncertain stealth seeds or corporate robin-hooding, but because the GM hybrid seed market was so oversaturated with legal brand choices that the differences between seeds were unrecognizable; that the deceptive labelling made those differences inconsistent; and the speed at which farmers changed brands precluded intimate knowledge of any particular seed’s performance. Having traded the iterative knowledge of seed choice first for public and private hybrids in the 1990s and then GM seeds in the mid-2000s, farmers as a whole switched seeds rapidly and copied their neighbors’ seed choices rather than basing their choices on their own production. This problem was not caused but exacerbated by GM seeds. With respect to seed choice, Warangal farmers as a whole had become deskilled. Despite this overreliance on social emulation, cotton farmers still conducted field trials of seeds 2012-2014 as experts observe. And yet because of the twisted routes that mediate cotton seed knowledge on Telangana farms, the knowledge about particular seeds' performance continues to be disregarded. The next section discusses the ways in which farmers conduct trials in the field, arguing that this environmental learning, unreliable as it is, is overwhelmed by social learning that is itself biased in favor of larger farmers who plant more seeds and work with seed sellers.

Bad Seed Trials in an Uneven Social Landscape

Stone (2007) referred to farmers as deskilled in cotton, reflected in aggregate seed fads rather than a detailed description of the trialing process. By examining seed trials I will show how farmers make decisions in spite of conditions inimical to informative trialing, and how these choices are mediated through the uneven social landscape of the village. Anthropologists generally try to avoid judgmental statements about the people who share their time and participate in research studies. I use the loaded term "bad" here to underscore that cotton seed trials are not only conducted with a technology that is inherently difficult for farmers to trial but that the trials are themselves conducted in a way that precludes learning about specific seed brand qualities and applying that knowledge. This is not a judgement of the farmers but of the conditions of cotton agriculture. There is nothing inherently wrong with quickly switching seeds, explains Warangal agricultural extension (ANGRAU) scientist Ramarao:

> If it is good they will continue next year. If it is not good, they won't continue. Here the farmers are very intelligent. Nobody will go blindly for one variety, as you say one hybrid continuously for three years. If it performs well they'll keep going with that hybrid. Otherwise they'll throw it in the dustbin…Suppose, based on his previous knowledge he may choose three varieties. Ok, then he will select three varieties for this year. And also based on his relationship with other friends, like other farmer friends, we're all farmers so we have chosen three varieties because in our discussion you might have told me other new varieties which have performed very well this year as your feedback. So I will also choose those two hybrids. So I will take those five hybrids and I will go with five hybrids and I will raise them in five acres. Different acres, one hybrid

> one acre only…due to our training programs, due to paper reading and by watching TV, now they have become more knowledgeable. So based on all this knowledge, what they are doing now, based on the performance of the hybrids they are choosing the hybrids and they are going for different hybrids in five acres or three acres or two acres. They won't go for a single hybrid in all five acres. Now the trend has changed entirely.
>
> Andrew: When did that trend change?
>
> R: Recently you can say in the past four, five years.

C. Rajesh expressed a similar sentiment above that bears repeating:

> The Indian farmer is looking for diversification. You know, even if your product is very, very good. The theory at least doing the rounds is that you know the Indian farmer never wants to put one hybrid, all eggs into one basket. Even if he's got a tiny farm of under five acres, even if it is five acres or ten acres, you take that you split it up between two, three, or four hybrids.

As these scientists explain, farmers are planting different seeds in different parts of their farm, which allows them to conduct trials and evaluate those results. This is (to them) economic rationalism. And yet that model poorly describes the fad patterns or the persistent general uncertainty on Telangana cotton farms. If farmers create careful trials and coordinate or otherwise use each other to test the wide spread of available seeds for the agronomically 'best' seed, then the fads would have greater lasting power. More to the point, if farmers conduct reliable trials, shouldn't the fad seeds give better yields? At least one of Ramarao's economic criterion is misleading: five seed trials in five acres is inadequate to test 1,000 possible windfalls, to say nothing of the problems with unlabeled, mislabeled, deceptively labeled, or aggressively promoted seeds procured from black market brokers. It is probably better understood as an attempt to hedge one's bets against the risk of a particular seed's failure than a vote of approval for that seed.

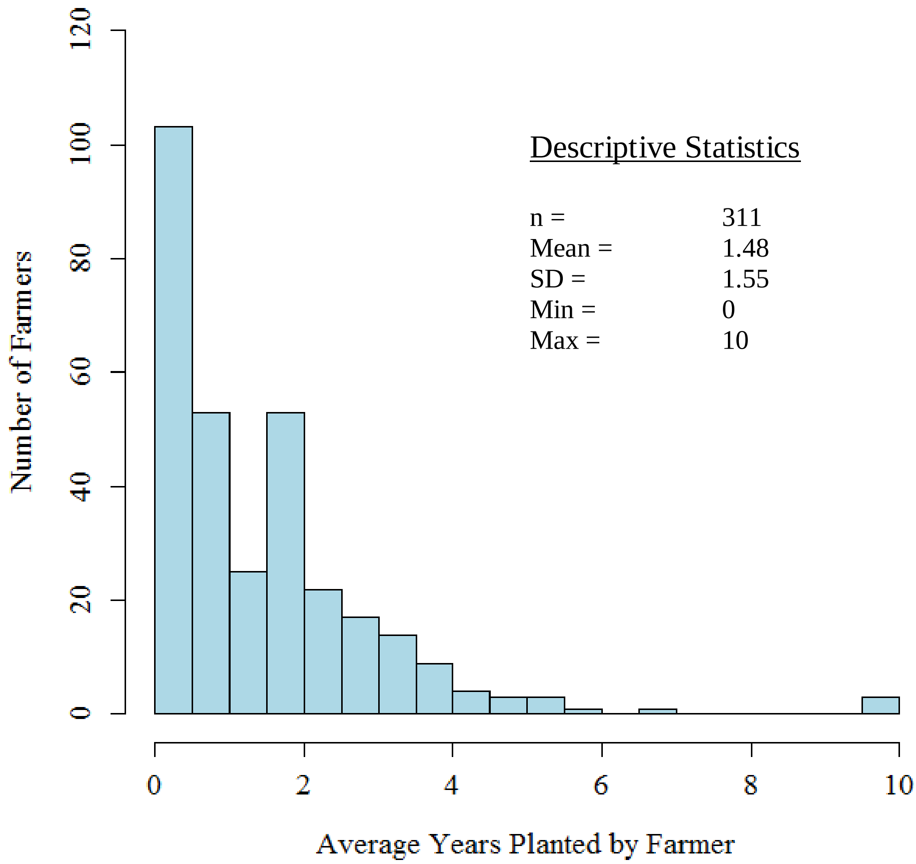
Another criterion of Ramarao's is exactly correct – farmers are trialing seeds. However, the mere presence of trials is not enough to say that farmers are actually generating agricultural knowledge. The trials are flawed, in that they are conducted without good knowledge of seed names and under differing agronomic conditions between farmers. It does not matter that farmers are not putting all of their eggs in one basket – they are not paying close attention to the eggs. There are two elements of this trialing problem. First, farmers respond poorly to their trials as shown below by my analysis of their yields and seed choices. Based on ethnographic data, farmers even complain that they do not trust their own environmental feedback. Second, the social emulation that drives farmer choices is biased in favor of what the largest, most socially advantaged farmers in the village choose, meaning that village level trials, in which farmers look to the village landscape to determine which seeds to plant, are also deeply flawed. I will address the first issue, that of flawed trials, first.

Neighbors planting different seeds can compare the relative productivity of their seeds, a way of reducing overall seed uncertainty and a means of environmental learning, even when the initial seed choice was made by using social emulation. However, these village-level trials are skewed by the variation in resources available to the farmers and the dominance of larger farmers in villages' real estate.

For farmer trials to be effective, they must be able to successfully differentiate between seed brands and recall their own seed choices. However, a huge percentage of farmers were not able to correctly recall the seeds that they had planted in the previous year. In 2013, I resurveyed 141 farmers on 624 seed choices from a 2012 pilot study in four villages. In 2014 an additional 288 farmers were resurveyed on 845 seed choices. Low seed recall when switching to hybrids has already been observed in India, as found when Tripp and Pal (2000) observed that 73% of farmers could not recall the particular millet hybrid in their fields. This is not the situation with cotton, where only 6% and 7% of farmer seed choices were "do not know" in 2013 and 2014 respectively. However among the farmers I resurveyed, only 57% and 41% of farmer seed choices in 2013 and 2014 respectively correspond to the seed choices they named during our interview the previous year – this problematic recall is nonetheless important as it is the information that farmers use to make seed choices. However, it presents significant problems for anyone attempting to accurately gage the diachronic success or failure of various seeds themselves, e.g. to prove that particular seeds are truly superior germplasm. This general uncertainty and reliance on neighbors is exacerbated by the fact that many farmers do not keep receipts year to year and throw away their packets. Those that keep their packets often misidentify seeds, change their answers midway through our surveys, claim to not remember seeds entirely, or are contradicted by the packets that they present in interviews. When farmers value buying 'the popular seed', individual seed names are less important.

Not only do farmers have a great deal of difficulty remembering particular names, they rarely plant seeds long enough to associate environmental information with those names (**Figure 5.2**). Many farmers even suggested that regardless of yields, one should switch to the newest

Figure 5.2: Average Number of Years Farmers Plant Cotton Seeds 2012-2014



Source: Flachs Farmer Survey 2012-2014.

seeds every year or at least every three years. This anecdotal pattern coincides with the three year curve of fad seeds, but it can lead to seemingly arbitrary switches. In one extreme case, a farmer who had planted Mahyco's Neeraja seed and received a decent harvest with it for nine years abandoned that seed in favor of Kaveri's Jadoo seed, which he had never planted but heard was successful in a neighboring village. "Everyone was planting this seed this year", he explained, and it would have been foolish of him to miss out on the widely believed best bet. The hope for high yields is paramount, allowing conformist bias to the fad patterns to take precedence over farmer knowledge.

Farmers discuss yields and inputs in the seed shops, under the shade of Neem trees, at the bus stop, in newspapers, in fields – in any place where farmers congregate. Who talks with whom and who feels comfortable approaching whom to discuss farming are matters mediated by social distance, caste, and wealth, but May and June are abuzz with rumors about new and old seeds. When I ask why farmers do not stay with seeds that they planted in the previous years, Srigonda *thanda* farmer Ramakoti explains "it is good to switch to new seeds each year or at least every once in a while. The companies start to get lazy after a period of success and farmers ourselves get complacent by planting the same thing year after year. Our switching, keeps the farmers and the companies working hard, doing the best work possible." In an agricultural environment defined by the fates of weather, seeds, and gods, Ramakoti refers to a sense of meritocracy - by working hard, one can succeed. Hard work does not manifest in clean, orderly farm spaces as it might in the social signaling found on an American farm (Benson 2012; Stoll 2002) but rather in the conspicuous consumption of pesticides and fertilizers, applying science and sweat to one's field work and always seeking improvement. His neighbor, Hatti Singh, agrees and explains that agriculture is a zero sum game: "You should always seek to produce more than your neighbors. If they spray four times, you have to spray five. That way, you'll always have the best yield. More than that, you have to treat the crop like your children, working hard and being attentive to its food and protection, giving sprays each week." More pessimistically, a farmer focus group complained: "If a new company's seed comes with a new name then it will give a good yield only for one year. Every farmer after that first year ends thinks that [that seed] will give a good yield. Then in the second year [the same company] gets duplicate seeds [to provide to farmers]." "That next year," I began, asking for clarification, "Duplicate aypotundi. Nakkali," the farmers finished: They will arrive as duplicates, fakes.

Even when seeds are bought in shops and the labels are themselves correct, farmers are hesitant to trust older brands. Thus have farmers gained a kind of environmental knowledge that it is good to hedge one's bets and mistrust older seeds, but it is knowledge that helps them avoid old seeds rather then choose new ones.

Confusingly labeled seeds are misremembered year to year and local knowledge contends that seeds should not be replanted too often because the companies themselves are not trustworthy. Yet as ANGRAU scientist Ramarao mentioned above, farmers do indeed plant multiple seeds in different fields and evaluate the results for a variety of phenotypic and agronomic traits. In focus groups, farmers mentioned looking for drought resistance, resistance to heavy rains at harvest time when cotton bolls are vulnerable to mold and rot, large boll size, high numbers of bolls, large plants exhibiting pest resistance – everything one might expect from a farmer trying to maximize their yields. Although they mix seed cotton from different brands together when selling at markets, farmers who buy multiple seeds rarely mix the seeds together in the field. Mixing seeds, farmers claim, would prevent them from seeing differences in the seeds that they plant. However, seed knowledge is so unreliable and transient and cotton so based in yield as a proxy for profit that farmers are willing to change their seeds in favor of any new popular seed: a tribal farmer with three acres planted five seeds in separate plots to compare height and boll size, but had no way of recording this information. Furthermore, he mixed all of his cotton together at the harvest and so could get only a vague idea of relative yields; a tribal farmer from a neighboring village planted his seeds separately but couldn't recall which seeds he had planted the previous year. When I asked how he decided what seeds were good to plant he told me that he followed "intelligent people" like his richer neighbors; a caste farmer who planted his seeds in separate spaces claimed to be looking for differences in sprays and diseases.

He told me in detail about the differences between three seeds that he planted, but he ultimately ignored this environmental feedback because his neighbor appeared to do well with two different seeds; another caste farmer planted his fields separately to evaluate differences in the seeds, but claims that seeds only work well for only one year and so does not factor in these differences when buying new seeds. Farmers are indeed overwhelmingly adopting Bt cotton seeds, jumping at fad seeds, and even trialing different seeds, but the social dynamics of the village for choices with this cash crop ensure that this adoption says little about farmer knowledge.

Yield in 100 kilogram bales per acre planted, the ultimate variable for this cotton cash crop in the minds of the farmers, responds poorly to factors associated with farmer knowledge including time planted, age, acreage, and number of seeds planted (**Table 5.3**) – all factors that should be related to environmental learning. Without a clear yield payoff for learning about seeds, farmers have no real incentive to stress environmental learning. Regressions that test the correlations per seed between age and yield, acreage and yield, and years planted per seed and yield show no relationship, while regressions that correlate the number of seeds that farmers planted with their yields or that test the previous year's yield as a predictor of the following year's yield are similarly inconclusive.

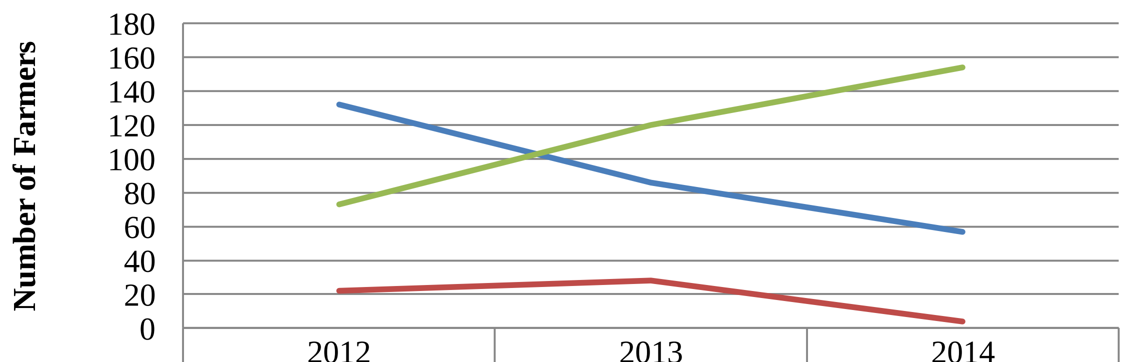
Table 5.3: Absence of Relationship between Yield and Elements of Environmental Skill or Status

2012	Yield Variable	Years Planted	Number of Seeds Planted Per Farmer	Age	Total Acreage	Cotton Acreage	Previous Year's Yield
n = 583 seed choices by 293 farmers	Linear regression of variable against 2012 yield (r^2)	.001	.003	0.005	0.007	0.000	.003
2013	Yield Variable	Years Planted	Number of Seeds Planted Per Farmer	Age	Total Acreage	Cotton Acreage	Previous Year's Yield
n = 445 seed choices by 226 farmers	Linear regression of variable against 2013 yield (r^2)	.022	.000	0.001	.003	.004	.008

Source: Flachs Farmer Survey 2012-2014.

While farmers do not show any qualitative or quantitative evidence of building knowledge related to seed choices, these farmers should be able to systematically trial and evaluate other aspects of cotton management, particularly planting density and pesticide spray payoff. However, the anxieties of seed uncertainty in the hierarchical social politics of Telangana village life lend special authority to expert advice. The imperative to do what shops, agricultural scientists, and other farmers suggest and what appears to be popular overwhelms actual trials of these management strategies. There appears to be a modest yield advantage in single lining, a higher density planting method, but more important are the various cost benefit analyses that the farmers apply when making that decision. Planting density is one kind of information that should be easily translated between fields – if I plant more, and have the resources to care for a dense crop (including increased weediness, increased water, increased fertilizer, and increased pest attacks), I can yield more. Between 2012 and 2013, farmers tested these methods. 74 changed their planting density and 25 tried a mix of low and high density to track the varying inputs and outputs. Others watched their trials with interest. Generally speaking 2012-2014, farmers tended to move from low density double lining, in which the cotton is planted in distinct horizontal and vertical rows, to single lining, in which cotton is planted in tighter vertical rows with no regard for horizontal lines. Forming two even lines, double lined cotton is easier to plow with a bullock while single lined cotton uses more of the available land. Forty percent of low density farmers switched to higher density planting, compared to 16 percent of high density farmers going to low density planting **(Figure 5.3)**. By 2014 the issue was largely settled, with a clear majority of farmers single lining.

Figure 5.3. Changes in Cotton Planting Density

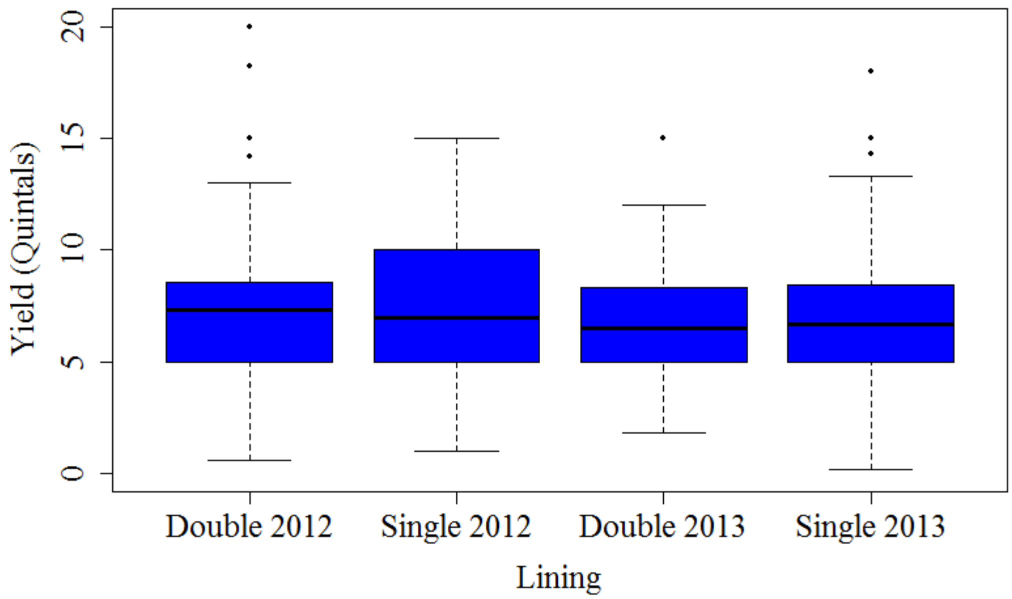


	2012	2013	2014
Double	132	86	57
Mix	22	28	4
Single	73	120	154

Source: Flachs Farmer Survey 2012-2014.

Yet higher density itself was not necessarily better yielding. A simple t-Test revealed no significant differences in reported yields of single versus double lining in 2012 or 2013 (**Figure 5.4**). Lining itself does not necessarily provide an advantage.

Figure 5.4: Yields from Cotton Single and Double Lining Reported for 2012 and 2013



<u>Descriptive Statistics</u>

	2012 Single	2012 Double	2013 Single	2013 Double
n	98	136	154	57
Mean	7.31	7.06	6.94	6.81
SD	3.45	3.76	2.94	2.63
Minimum	1.0	0.0	0.0	1.8
Maximum	23.33	23.33	18.00	15.00

Source: Flachs Farmer Survey 2012-2014.

Single lining is, however, necessarily more expensive in that it often requires a higher investment in picking labor, weeding labor, pesticides, water facilities, fertilizers, and seed packets. And yet, as shown above, single lining is increasingly popular for farmers as a whole. Why follow a more expensive planting strategy with ambiguous results?

In part, this shift in planting density is being pushed off the farm. Shops and university extension agents promote dense planting as a way to increase overall yields. The Warangal and

Akola agricultural universities servicing Telangana and Maharastra farmers were testing plots of various densities in 2014 while extension agents in Warangal were recommending a single line spacing of 90 cm between rows and 60 cm between plants to achieve a production boost of 25-40%. Farmers in this sample did not achieve this boost, but they appear to be willing to try. On one hand, the influence of universities and shops should be credited, as farmers planting unfamiliar seeds ask shops how to plant the seeds, and the extension scientists regularly communicate their findings to the shops. Alternately, single lining may appeal to farmers as a risk reduction strategy, as farmers pointed out that in the event of unpredictable weather patterns, the sheer number of single lined plants might make up some of the loss felt by a more sparse system. In either scenario, buying more seeds and devoting more resources to these plants is easier for farmers who have more of these resources and better access to them. Larger farmers of higher caste can cultivate friendly relationships with shops and extension agents, while it would be very unusual for large farmers to follow the suggestions of poorer, lower caste villagers. This speaks to the second problem in seed trials and in cotton agriculture generally: the social emulation that disrupts trialing is itself biased in favor of larger farmers for a variety of agricultural and sociological reasons.

When asked how he might solve unexpected insect problems in his cotton crop, one small farmer replied “If I have any problem [with insects] I should try a different pesticide, then take that plant to a fertilizer shop, where the shop owner will tell me what to do.” “Won’t the owner just try to sell you something else,” I asked? “If you spend some money, they’ll help. If not they won’t,” he replied. “And what if you can’t afford an expensive pesticide,” I continued. “We are poor people,” the farmer explained. “You could take up a collection if you can’t pay, or you could ask a large farmer for help.” Another farmer was more direct: “I haven’t studied or gone to school, how can I know what is best – I ask large farmers and shops for help." As members of a dominant class only sixty years ago and enjoying caste or direct family connections to business owners in the current economy, larger farmers are endowed with a responsibility to guide and help the rest of the village when possible, making them ideal models for small farmers. Their accumulated wealth also provides a decisive advantage in management, securing and knowing about loan programs, and working with new technologies.

The Influence of *Pedda* Farmers in Social Learning

Rajaiah wasn't sure which cotton seed to plant in 2013, and so he did what many small, low-caste farmers do in this situation. As a day laborer (*kuli*) on the field of a rich farmer, Rajaiah assumed that his employer had a good reason to purchase the seed and copied his choice of Kaveri's Jackpot seed in his own field. In some years, the high caste farmer even buys the seed for Rajaiah. He wasn't sure exactly what seed he had purchased but after I asked him to bring the seed packet he nodded with recognition. "It's Jackpot. All are taking Jackpot this year so I am too." Why take the popular seed, I asked? He laughed, half-exasperated and half-joking. "*Oka gorra bavilo paritha, anne gorralu bavilo paritha,*" he answered, a proverb that translates: if one goat jumps in a well, all goats jump down the well. When farmers can't know that a trusted seed will be a better choice than a dozen new varieties, they turn to local experts. The irony is that those farmers with the greatest social prominence are not farming any better than the rest of the village.

Social stratification within small villages in Telangana is readily apparent through competitive conspicuous consumption, as in much of rural India (Linssen, Kempen, and Kraaykamp 2010). Manifesting in tractors, satellite dishes, livestock, or fresh paint, farming and rural life often have a competitive bent to them. In a day of interviewing it is common to speak with both large and small farmers and to hear divergent narratives from each. The answer to almost any question on seed choice is '*manci digabatu*' (good yield), a frustratingly vague and obvious claim that farmers are hoping for a good yield with the new seed. This good-ness is defined by health, boll size, pickability, number of flowers, and insect resistance, but all of that is subservient to a seed's potential to yield a large amount of undamaged, heavy cotton that will fetch a good price in the market. The refrain of *manci digabatu* can get tiresome for an interviewer, but it underlies the fact that farmers are so willing to chase profit margins that they are happy to forgo some of the skilling process that affects seed decisions and puts pest management in the hands of the seed shops in the hopes that they'll have a great harvest like they've seen in newspapers or on television about. "Good farmers can keep track of prices, sell when the time is right, buy new seed each year because the company knows best, and plant different cotton seeds to see what is good and what is bad," explained Narayana, a larger farmer. As we walked through his field, he showed me how he is affirming his previous trial with Neeraja seeds by comparing how his brother's plants look pitiful next to his own and judging the many neighbors whose fields lead the way to his own. "I am a good farmer," he bragged, "because I have educated sons who help me read and keep track of prices and seeds. Also, I have many of friends in the shops and in the agricultural offices. Between all of these insiders I can continue to do well." Although these advantages do not pay dividends in cotton yields on the aggregate, they may give help some larger farmers and give them undue influence in the social learning pool on the village level.

In cotton seed market with hundreds of choices, there is a logic to social learning, where farmers copy neighbors when making seed decisions. The question, 'why did you choose this seed this year' is often answered with 'because it is popular', a circular argument that speaks to general uncertainty in seed choices. Farmers often have no satisfactory answer to that question because of the overwhelming combination of rumors, advertisements, and unclear environmental feedback from their own fields. Given that they must make an important decision while weighing hundreds of options, farmers have to draw on different types of learning to cut through the noise. There is no way for a single farmer to trial all possible seeds on their own farm, and so using neighbors as tests adds breadth to their knowledge base. By seeing their neighbors and comparing those kinds of production, they can build environmental knowledge from that initial choice. Furthermore, farmers know that their neighbors are also testing seeds, and so their decisions are based in a calculus of what they themselves know, what shops or intervention programs have told them, what they've seen on neighbor fields, and the presumably well-informed decisions of others that they seek to copy – this was Ramarao's argument. While this argument does not consider the uneven flow or retention of seed information, social learning cannot be totally distinct from environmental learning, in the sense that people do not plant things that they expect will yield poorly. A Kavrupad farmer focus group member offered the following advice: "When you're planting for the first time you should ask all of your neighbors about seed choices and what is best. They'll let you know about their yields and you can make a decision based on the way in which the harvest comes." Another farmer added, "you'll be asking about ten neighbors and based on their suggestions you should plant the best one." What goes unsaid in such comments are the dynamics of who asks whom about planting, a more social than environmental set of decisions.

Unsurprisingly, larger farmers have access to more land and therefore have a greater ability to plant more different kinds of seeds. However, they cast an influence over seed choices in more directly social ways. The Telugu phrase for a large farmer is *pedda raytu*, which connotes that the farmer in question has sizable holdings but also that he or she is of higher status and importance in the village. In South India generally, caste and power are historically linked to holdings and relationships of labor whereby poorer farmers in the village work for richer farmers with more land (Guha 2008; Mines 2005; Vasavi 1999). These historical relationships ripple into the present. To be a large farmer is to be well-respected, be relatively wealthy, to have the potential to make your land productive, to be trusted by creditors, to hire others to work for you rather than vice versa, and to have influence over others in the village as a function of these historical and material advantages. The combination of these factors gives the *pedda* farmers a negligible edge in agricultural capabilities but a large advantage in socially mediated access to knowledge and resources.

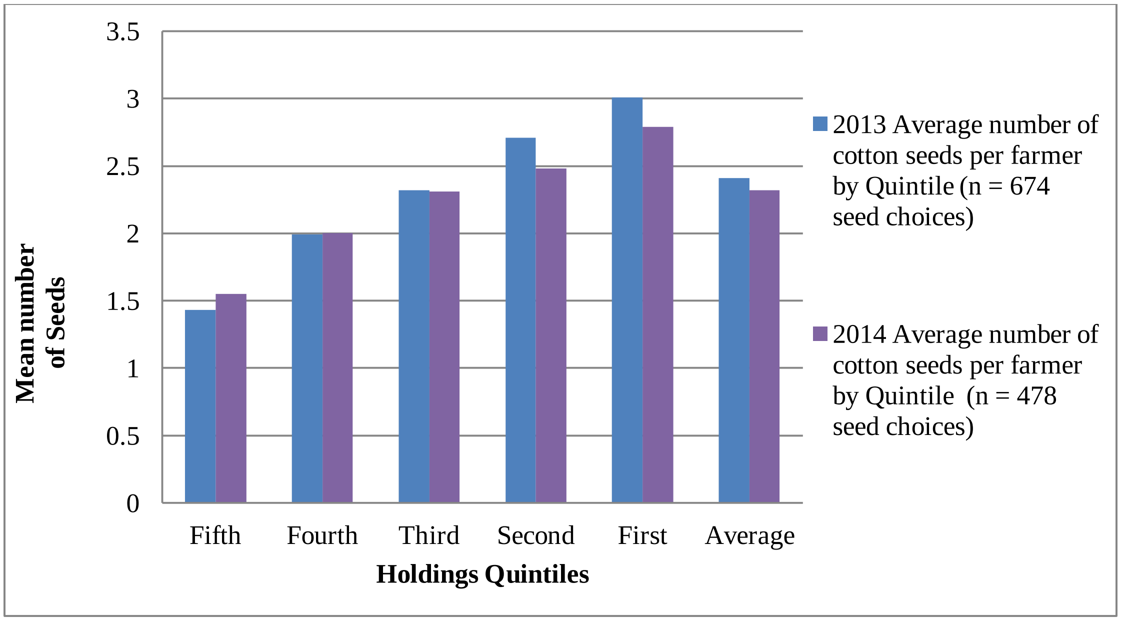
There are three questions that should be asked to see if larger farmers are indeed benefitting from more environmental learning:

1. Are larger farmers planting more different kinds of cotton seeds
2. Are they learning about them over a longer period of time?
3. As farmers report that yield is the be-all and end-all of cotton agriculture, are the larger farmers getting some kind of yield advantage from that environmental learning advantage?

I will examine the first question first. Looking to the largest 20% of farmers in my sample, those who stand out in their villages as larger farmers, this group consistently planted more different kinds of seeds, planted them over a longer period of time, and planted fad seeds along with everyone else; in 2013, an uncertain 'valley' year in the fads (**Figure 5.1**), *pedda* farmers were the biggest replanters of seeds with which they had experience as well as the biggest planters of new seeds. Additionally, the large farmers have the most income and take on the most debt, meaning that they can afford to take better care of and invest more in their fields; they are more likely to belong to a higher caste, affording them contacts and respect in extension and political institutions; they tend to be better educated and have more livestock and machinery. In 2013, this top quintile was above or nearly above the average of the bottom 80% of farmers in several relevant social and agricultural categories (**Table 5.4**). Differences in yield, education, and assets were deemed to be not statistically significant between the top 20% of farmers and the bottom 80% at the level of $p \leq .05$, although asset scores were close to that value. The advantages in yield, education, and assets should thus be understood as general trends rather than statistically significant differences. It should be further noted as explained below that the household data referring to income, assets, and education were drawn from a subset of the farmers in Ralledapalle and Kavrupad, and do not represent all farmers. The five OC farmers in the household survey subset had holdings in the fourth or fifth quintile while nine of the ten SC farmers had holdings in the first or second quintile. ST farmers are not stratified along caste lines and so exhibited a more even distribution throughout the five landholdings categories.

Do larger farmers plant more seeds than smaller farmers, giving them more chances to trial more technologies? A related line of questioning asks, do larger farmers plant their seeds for longer periods of time, giving them more environmental knowledge about the seeds in different weather conditions and different years? In the periods of uncertainty between fads, time is a luxury. Extended experience with a seed is precludes the planting of a new, potentially lucrative seed. If deskilling is the failure to build environmental knowledge on seeds or an interruption of that process, wealthier, larger, higher status *pedda* farmers might avoid this by planting more different kinds of seeds over a longer period. On average the largest quintile of farmers planted 3.01 and 2.79 seeds to the smallest quintile's 1.43 and 1.55 seeds in 2013 and 2014 respectively (**Figure 5.5**). Three seeds planted by a single farmer may not make for an instructive experiment in and of itself, although it is certainly a better experiment than only planting one seed.

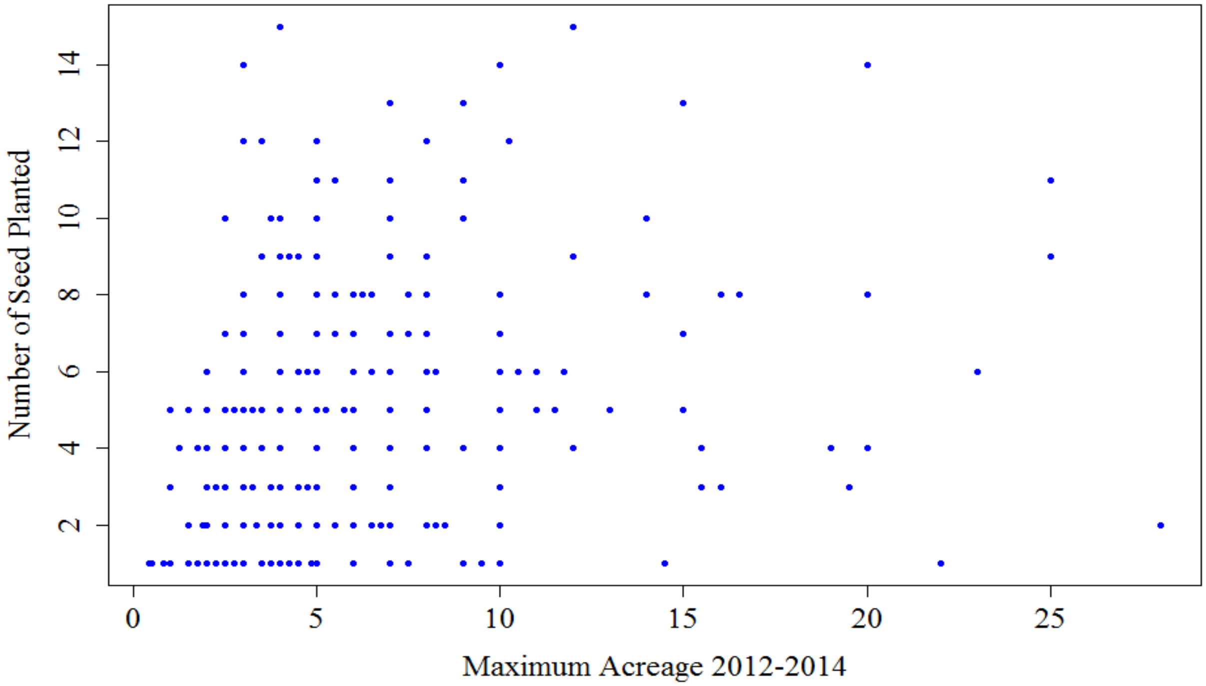
Figure 5.5: Average Number of Cotton Seeds per Farmer per Year by Quintile



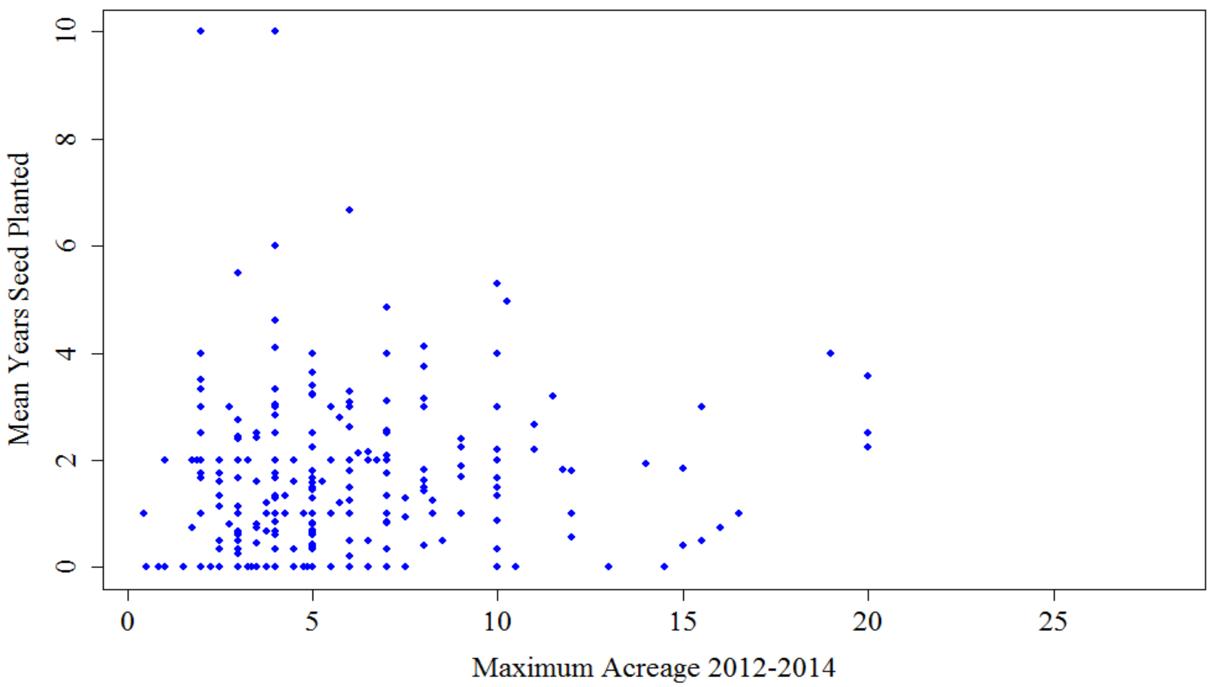
Source: Flachs Farmer Survey 2012-2014.

However, when viewed as a direct relationship, the differences in the number of seeds or the years that a particular seed will be planted again become lost in the noise of social learning on the village level (**Figure 5.6**). Size turns out to be a poor predictor of both the number of years that farmers will plant given seeds and how many different seeds they might plant.

Figure 5.6: Number of Seeds Planted per Farmer and Years Planted per Seed as a Function of Maximum Holdings Size per Farmer During the 2012-2014 Planting Seasons



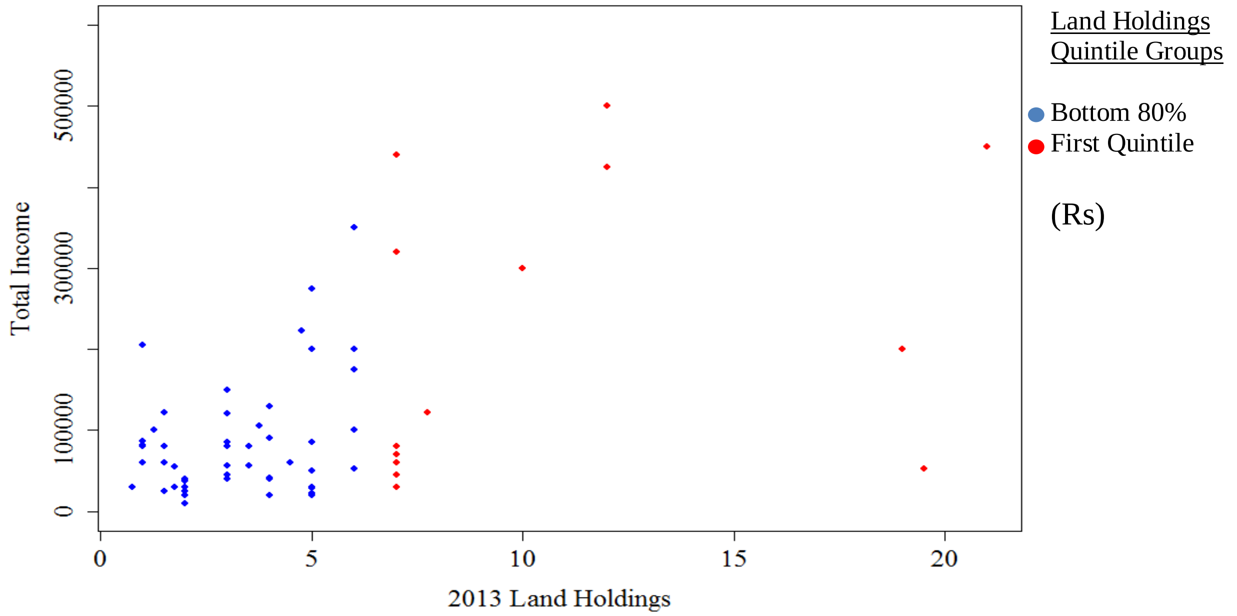
Linear regression of maximum acreage 2012-2014 vs. number of seeds planted r^2 = .084
n = 322

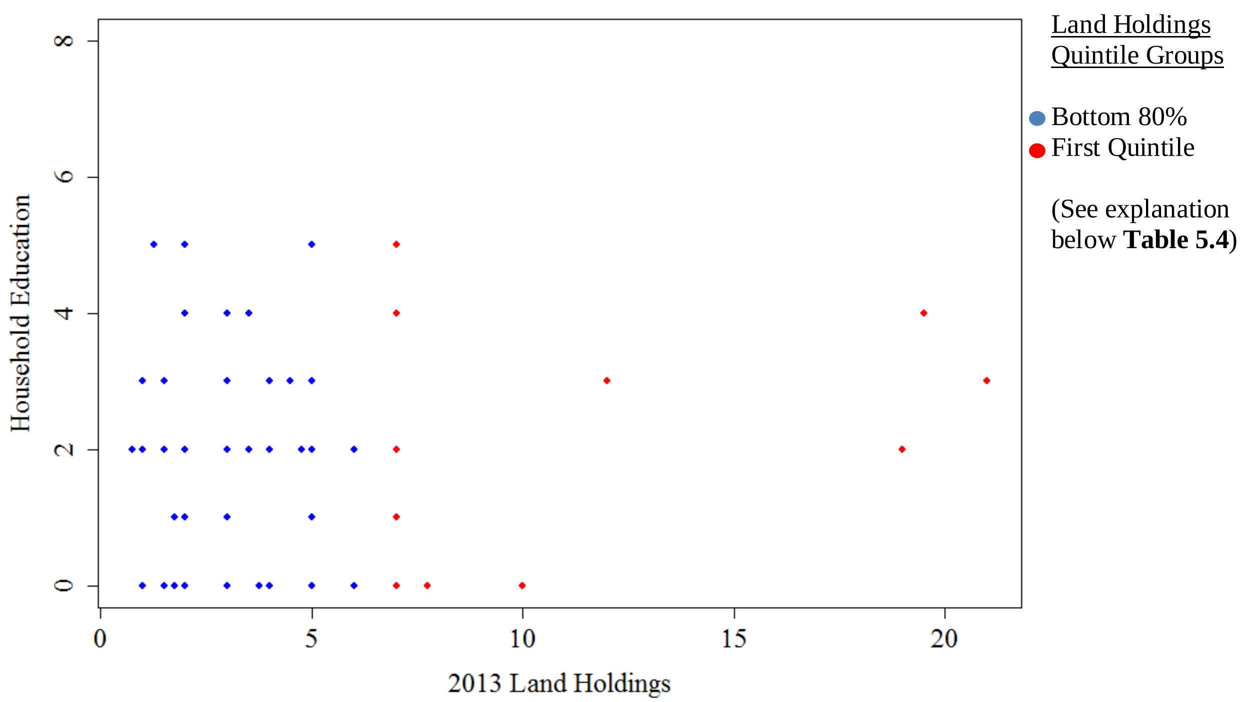


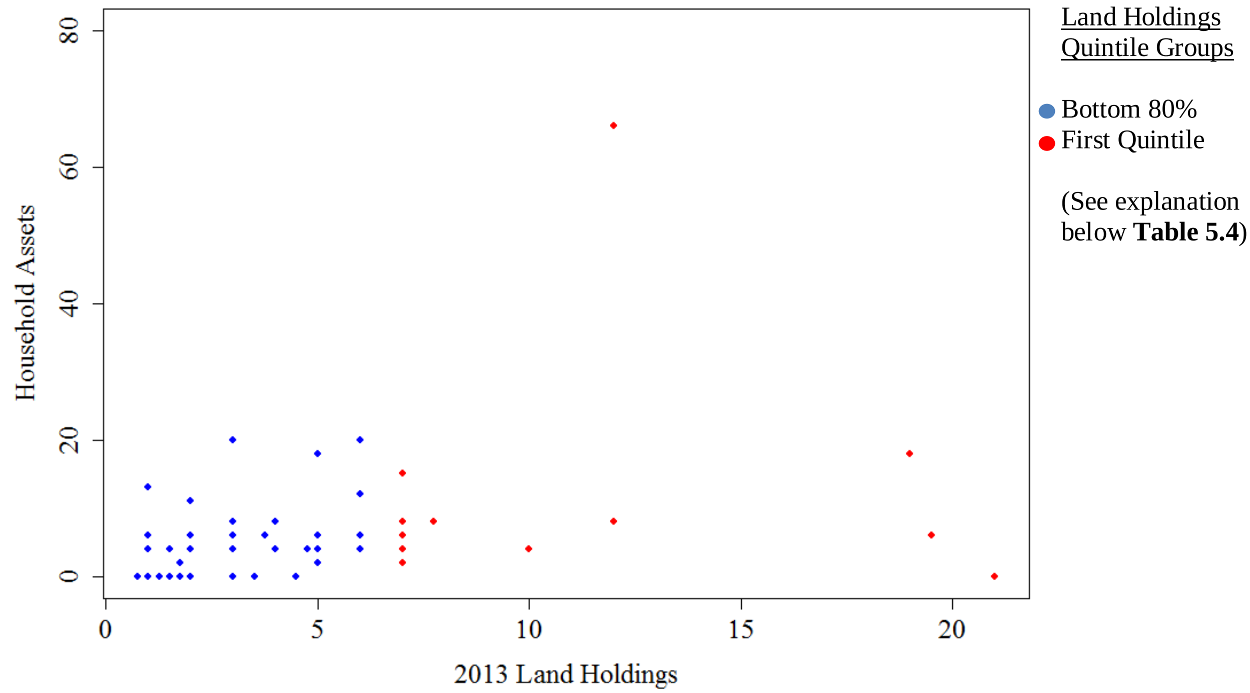
Linear regression of maximum acreage 2012-2014 vs. mean years seeds planted r^2 = .007
n = 310
Source: Flachs Farmer Survey 2012-2014.

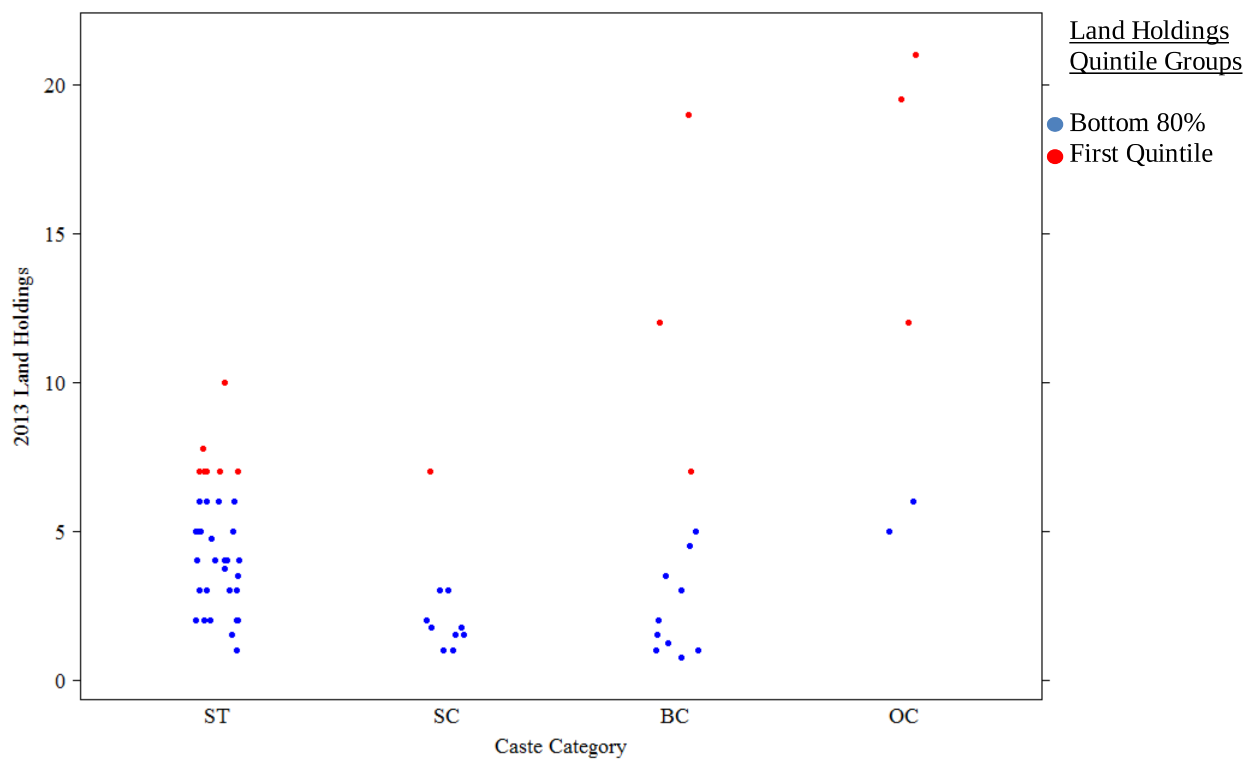
Given the large sample size and the very small coefficients of correlation, we can conclude that there is no association between acreage, indicative of this *pedda* status, and the years that farmers trial seeds or the number of seeds that they trial on their land. Large farmers thus did not have demonstrably larger yields, did not benefit more from single or double lining, and ride the seed fads along with everyone else. Further, none of these associated environmental learning factors or cotton management strategies gave a yield payoff significant to analyzing anthropologists or to farmers who would be looking for clear differences in the field. So why does the rest of the village invoke their names when discussing seed choices and expertise? Larger farmers do enjoy some benefits related to social access to resources and information, especially those at the top of the land holdings scale. In some instances, such as the yields, education, and asset scores, they are best conceived as farmers on the end of a cline, or at least farmers who are least likely to be among the lowest group (**Figure 5.7**). In others, such as the number of seeds they plant each year, their income, or the number of years that they replant their seeds (a measure of using a tried and true technology), they are statistically different than their smaller village-mates (**Table 5.4**).

Figure 5.7: Scatterplots Comparing 2013 Land Holdings and Socioeconomic Characteristics of the *Pedda* Farmers









Source: Flachs Household Survey 2013.

Not every large farmer will fall on the highest edge of these different spectra, but these scatterplots, taken from the 2013 Household survey of 65 farmers in Ralledapalle and Kavrupad illustrate that larger farmers tend to have more income, tend to be somewhat better educated, tend to belong to higher castes, and tend to have more assets. Neither household education nor asset scores are statistically significant, but as the graphs show, *pedda* farmers tend to fall on the upper register of these scores, and rarely fall on the lower parts of the graph.

Table 5.4: 2013 Social and Agricultural Comparison of top 20% of Farmers Vs. Average of Bottom 80%

	Q1	Q2-5	p value
Mean seeds per farmer	3.06 SD = 1.63 n = 72	2.19 SD = 1.21 n = 206	<.001
Mean Years replanted per farmer	3.2 SD = 2.01 n = 54	2.77 SD = 2.01 n = 129	.095
Mean 2013 Yield	6.7254 SD = 2.51 n = 48	7.056 SD = 2.90 n = 167	.780
Mean Income (Rs)	221,036 SD = 177,735 n = 14	83608 SD = 70,937 n = 51	.007
Mean Household Education	2.14 SD = 1.61 n = 14	1.71 SD = 1.49 n = 51	.186
Mean Asset Score	11.07 SD = 16.5 n =14	4.67 SD =5.32 n = 51	.088

Income, Household Education, and Asset score are derived from a purposive sample of 60 households in Ralledapalle and Kavrupad that was representative of the 120 farmer random sample in holdings, wealth, caste, and cropping. Household education was determined by assigning a score of 0 when no farmers in the household were educated; 1 when no farmer was educated the 5th class; 2 when someone in the household was educated beyond 5th class; 3 when multiple farmers were educated beyond primary school; 4 when a farmer in the household had attended university classes, and 5 when multiple people in the household had attended university classes. Asset score was determined by assigning numerical values for animals and machinery: 1 per goat; 2 per cow, bullock, or buffalo; 4 per small machine like rototiller or generator; and 8 per large machine like rice harvester or tractor. A larger asset score indicates that the farmer has more livestock and machinery, with machinery weighted higher on this scale. Source: Flachs Household Survey 2013.

And yet, despite having income and assets available to care for their plants larger farmers enjoy no yield advantages (p = a staggering .780). Their advantage is often more social, even psychological: "We're the same caste" explained one *pedda* farmer when I asked if he could trust the advice of a local shopowner. "He wouldn't lie to me." This illuminates an important point. During the 2012 seed crisis explained at the beginning of this chapter, brokers played an important role in securing lines to fad seeds, sometimes providing spurious seeds and always adding on extra costs. Even during other years, vendors continue to supply many farmers. When comparing farmers' cotton seed vendors 2012-2014, smaller farmers, lower caste farmers, and tribal farmers were more likely to buy seeds from travelling brokers or to ask larger farmers to bring seeds back with them during trips to neighboring cities like Nekkonda, Warangal, and Siddipet. Some of the reasons for this disparity are obvious, historical, and structural: large, rich, high caste farmers hire poor, low caste farmers as agricultural laborers while the reverse is unthinkable within the village hierarchy; travelling brokers more often visit tribal *thanda*s because those farmers are less mobile due to a combination of poor roads, greater distances from public bus routes, ethnic differences from shop owners, and because these *thandas* lack agricultural input shops; wealthier farmers are more likely to have working business relationships with shop owners who are, like them, native Telugu speakers and are more ethnically similar.

The first sign of seed vulnerability at the shops comes in the form of the 476 out of 1,370 (35%) seed choices 2012-2014 for which the farmers answered that they did not know the name of the shop or vendor where they purchased their seeds. Some discarded their receipts or seed packets while others were unable to read the documentation they had. In several of the 'do not know' cases it is also possible that farmers were hesitant to answer that they had procured seed from a black market broker. Farmers who do not know where they got their seeds by definition have a poor relationship with shops and shop owners. Much to the amusement of his nearby friends and relatives, an elderly tribal farmer once took me to task for asking so many specific questions about his seed acreage and shop connections: “How can I remember how much [cotton acreage] I have? What I take, that much I'll put” he shouted. When I asked him the name of the shop owner where he got his Bt cotton and the name of the seed he rolled his eyes: “I ask for cotton, he gives me what he thinks is best, he doesn't ask my name, I don't ask his name, I don't say my name, and he doesn't say his - he just takes the money and I take the seeds and that's it”.

Removing the third of seed choices for which farmers did not remember where they procured their seeds, an uncertainty well represented among all kinds of cotton farmers, black market brokers provided 12% of cotton seed choices 2012-2014 (**Table 5.5**), the second largest vendor after the Srigonda cooperative established in partnership with the agricultural extension service to provide reliable inputs to Kavrupad, Ralledapalle, and Srigonda farmers.

Table 5.5: Seed Vendors Accounting for Greater than 1% of sample 2012-2014

Vendor name	Seed choices from Vendor	% of total choices
Mahalakhsmi Cooperative	165	18.56%
Broker (Black Market)	112	12.60%
Swathi Fertilizers	108	12.15%
Bikshapathi Rao (local dealer)	65	7.31%
From Unspecified Relative	48	5.40%
Vijay Lakshmi Fertilizers	35	3.94%
Maruthi Fertilizers	30	3.37%
Kalpenna	22	2.47%
Deva Sai	21	2.36%
Mandal Office	19	2.14%
Sona Fertilizers	17	1.91%
Uma Maheshwara	17	1.91%
Vasavi Fertilizers	17	1.91%

From Unspecified *Pedda* Farmer	14	1.57%
Vamshi	12	1.35%
Sri Rama	12	1.35%
Hanuman Fertilizers	11	1.24%
Madhavi	9	1.01%
Venkateshwarlu Fertilizers	9	1.01%

Source: Flachs Farmer Survey 2012-2014.

Most of these vendors are Warangal seed sellers who have set up dozens of shops on a strip of prime real estate near the bus and postal stations. "From relative" and "from *pedda* farmer" are also common sources of seeds here. As shown by the discussion of the 2012 seed fad, seeds purchased from brokers place farmers at an additional risk for spurious seeds. There is no direct relationship between size and vendor choice, and as indicated in the table above, some smaller farmers buy black market seeds from larger farmers who travel to other districts or state to procure them. However, it is interesting to note that: farmers with the largest 20% of landholdings bought comparatively fewer seeds from brokers than the other four (8.3% compared to 14.54%); all but one of those black market choices by the largest farmers came from large tribal farmers and high caste farmers from Gongapalle, a village where large and high caste farmers sell to poorer neighbors; and that a combination of black market brokers and *pedda* farmers sold one quarter (49 out of 196) of the cotton seeds planted by the smallest 40% of farmers 2012-2014.

As an aggregate group, larger farmers are somewhat protected from the risks of an uncertain seed market by their higher status and greater access to resources. They are rarely among most vulnerable members of the village in using and testing agricultural technology like new GM seeds. This is not to say that any particular social edge be it caste, income, or acreage guarantees or predicts agricultural success, in the same way that car or television ownership does not make people healthier globally: these correlates are ways of triangulating the phenomenon by which large, socially important farmers have a reduced seed choice risk during the collective uncertainty that befalls farmers in the wake of seed fads.

The conclusion that larger farmers tend to be richer, have more assets, and carry more weight in the village, or at least that they are almost never among the lowest members of the community in these categories, should be obvious. What is more surprising is that the comparison of yields and sprays, lining, income, assets, acreage, seeds planted, age of farmer, and experience with the seeds shows that none of these factors are directly related to farmer success. There is too much variability to conclude that the larger and rich farmers have real agricultural advantages. Rather, they benefit from practicing larger-scale agriculture and working with agricultural experts. The confusing seed market fits their particular mix of socio-agricultural resources only in the sense that it is slightly less important for these farmers to have intimate knowledge about their cotton seeds. That they do not perform better than anyone else in this environment is inconsequential because larger farmers can better afford to be deskilled.

This section has shown that the trials that farmers conduct with cotton seeds, sprays, and planting densities are not just unreliable but fundamentally flawed because they are biased in favor of larger farmers. The next section looks for ways in which social learning is uneven on the village level, and argues that larger farmers help to drive seed fads by bottlenecking the available visual real estate. Thus when farmers socially learn, they are more likely to learn and follow the largest farmers. On a local level, this helps to drive herding behavior. This situation works well for *pedda* farmers, who have the resources to match and the social clout to investigate potentially lucrative seed choices and management strategies. It works poorly for the smaller farmers who follow larger farmers without the means to replicate the inputs or conversations with agricultural extension officers that made large yields possible.

The Undue Influence of Larger Farmers in Seed Fads

The logic of seed fads as justified during a Kavrupad focus group follows a rational economic choice on the village level:

> So you have planted one seed in one acre. Another farmer has planted another half acre. In the village there are ten acres: one person plants a different variety, one person plants a different variety, one person plants a different variety, one person plants a different variety, this person here plants a different variety. In all these varieties whichever gets a good yield, all will take and plant that one [kind of seed].

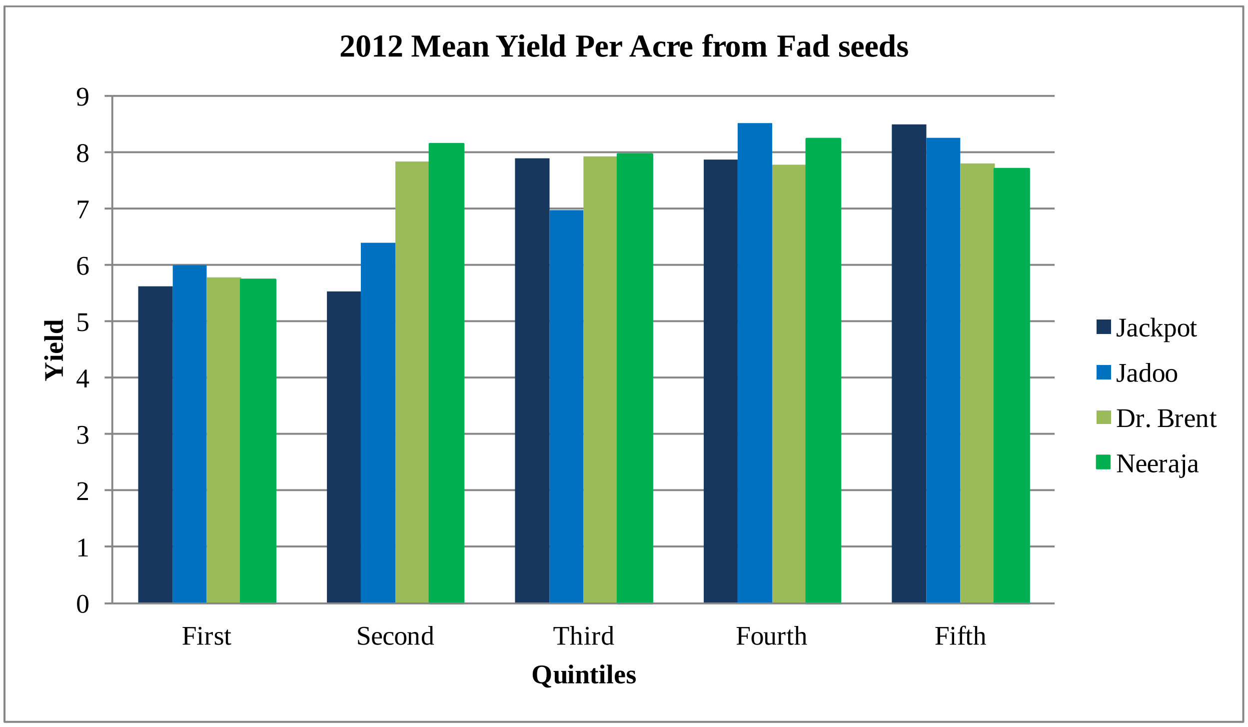
There are too many seeds for any individual farmer to trial and so the village trials a mix of seeds to determine what will work well. As a whole, this farmer explained, by observing the results of annual trials, the village can zero in on the highest yielding seeds, thereby explaining the fads. When viewed uncritically, this appears to be more environmental learning, just on the village level. No individual farmer could possibly test all of the potential seeds, and so farmers use the village as a giant test plot. Indeed, GIS analysis in Ralledapalle and Kavrupad suggests that field neighbors' choices in a given year are a better predictor of a farmer's seed choices in the following year than the choices of the farmer themselves (Shaffer and Flachs 2014). However, this perspective on seed fads assumes that all of the farmers have an equal opportunity in planting seeds, caring for them, and observing the results. 2012-2014, the largest 20% of farmers planted nearly one out of every three cotton seed choices available to be emulated. The largest 40% were responsible for more than half of the cotton in the village while the smallest 40% in any given year controlled a quarter or less of seeds planted in the village. Farmers therefore do not have a representative sample of seeds on which to base their social emulation. Rather, their socially driven seed choices are a bottleneck of what the larger farmers prefer.

Farmers often comment that they look for “famous” seeds: “*E samvacaram andaru pettaru*” explained one farmer in 2014 when I asked why he chose to plant Kaveri’s Jackpot seed: “Everyone was putting this seed this year.” This is a clear example of *social* learning, in which farmers emulate the decisions that their neighbors make. Yet there is so much uncertainty over which seed is best that even as farmers leap on the seed bandwagon in fad years (**Figure 5.1**) they also keep a careful eye on their neighbors’ *environmental* success for next year’s seed choice. “If we all plant different seeds”, one farmer explains, “whoever gets a good production is the person that we will follow next year for a good cotton yield”. Given the number of possible seed choices, farmers try to use their neighbors as tests, sometimes even planning with neighbors and relatives to buy different seeds and compare notes. In a 2014 focus group, I asked farmers about Yuva, that year’s fad seed. Their answers, “*Yuva baaga vastandhata*” (Yuva will yield a large amount) or “*Yuva mancigane vastundhata*” (Yuva will fruit in a good way) were inflected with the Telugu suffix ‘*ta*’, meaning that this knowledge is secondhand, unwitnessed by the farmers themselves. It is therefore uncertain and unreliable, hoped-for but not yet confirmed. In village-level experimentation, farmers try to reconcile their own experiences with certain seeds with that of others around them in the name of finding a seed that can deliver a good yield and a good return on their investments.

As yield is the most important criterion in seed quality, fad seeds should yield better if they are a trialable technology: the fads and their shifts should reflect yield advantages. However, fad seeds do not seem to have a high yield response. Instead, fad seeds are slightly preferred by larger farmers, who are additionally blessed with higher incomes, more assets, and better working relationships with local agricultural experts like shop owners and extension officers. Because any given seed that farmers see in a sweep of fields is as likely as not to belong to a larger farmer, social emulation based in following one's neighbors would favor the choices preferred by large farmers even in a social vacuum, where these farmers did not enjoy high status in the village. However, because of the particular choices that these farmers are making, their seed decisions help to build fads and herding behavior. The rise and fall of Mahyco and Kaveri company's seeds across 2012-2014 helps to illustrate this phenomenon.

If the social learning phenomenon of village level experimentation worked perfectly in 2013, many new farmers should have planted Mahyco's Neeraja and Dr. Brent (labelled in green) rather than Kaveri's Jackpot and Jadoo (labelled in blue), because these seeds performed at least a little better for some farmers than the Kaveri seeds (**Figure 5.8**).

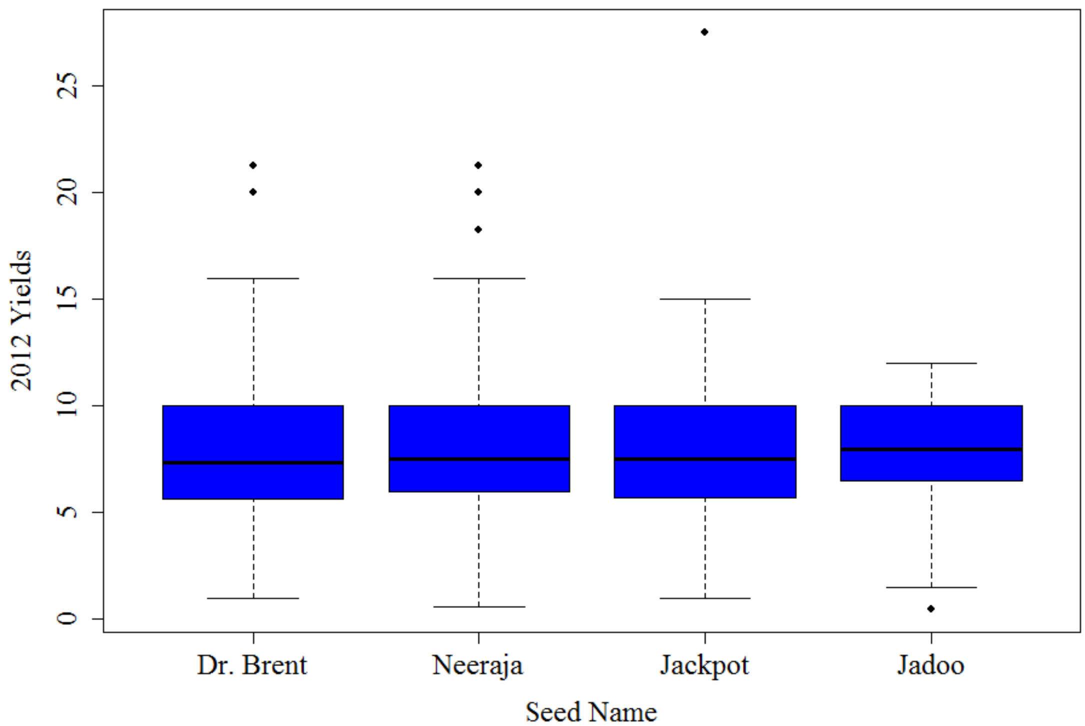
Figure 5.8: Mean Yields per acre from Seeds Planted 2012 by Holdings Quintile



Source: Flachs Farmer Survey 2012-2014.

In fact, Kaveri seeds saw dips in yield on average for the smallest 60% of farmers. When examined statistically, the differences between the seeds drop away, overwhelmed by a large standard deviation that would cause difficulty for any farmer trying to environmentally evaluate the 'best' seed based on last year's performance (**Figure 5.9**). Given that smaller farmers did worse with Kaveri seeds and farmers as an aggregate did no better with Kaveri than Mahyco seeds, there is little environmental reason to explain why Telangana farmers abandoned Mahyco for Kaveri with such zeal.

Figure 5.9: Boxplots for 2012 Fad Seed Yields Per Acre



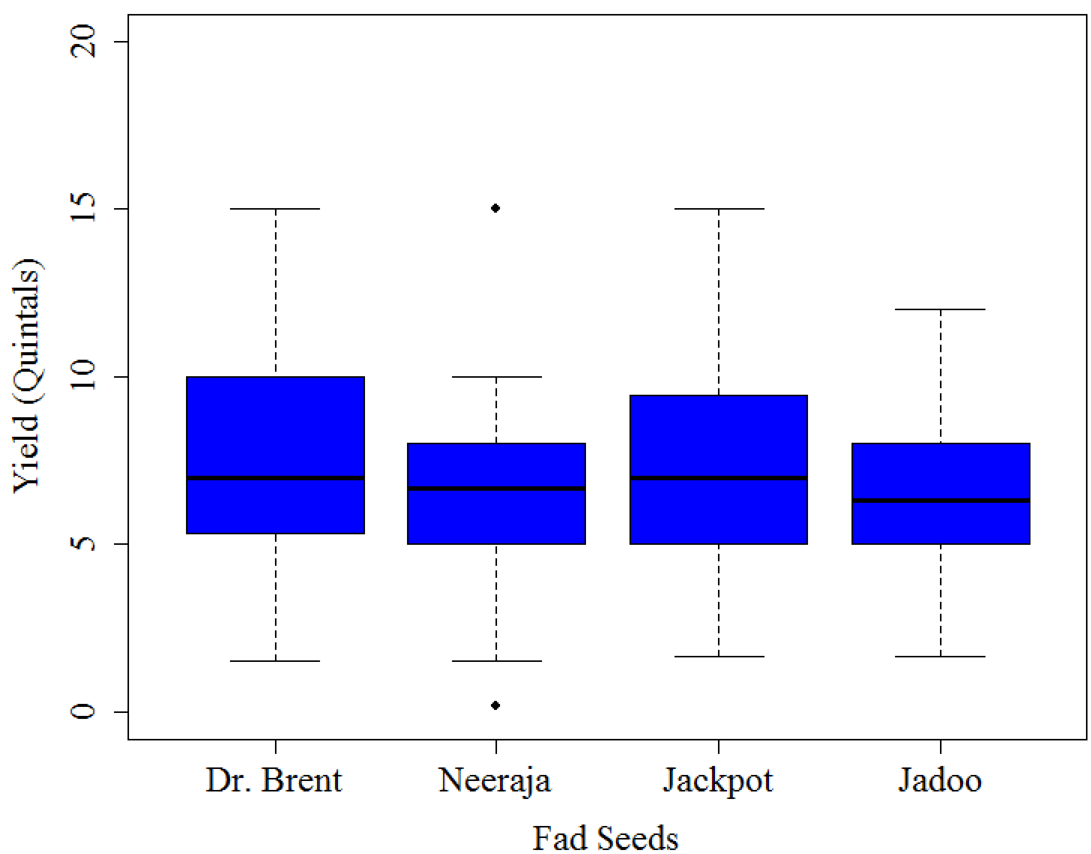
2012 Fad Seed Yield Descriptive Statistics

	Dr. Brent	Neeraja	Jackpot	Jadoo
n	124	137	54	24
Mean	7.68	7.89	7.51	7.76
SD	3.59	3.56	3.29	2.87
Minimum	1	.58	1	.05
Maximum	21.25	21.25	15	12

Source: Flachs Farmer Survey 2012-2014.

Reasons varied for the switch: a few especially productive farmers, an advertising blitz for a new seed in concert with the unpleasantness generated by the 2012 seed scarcity, and a suspicion that seed companies produce subpar seeds the year after they enjoy faddish popularity helped push Kaveri's Jadoo and Jackpot over the edge. Despite no clear environmental feedback, farmers were well on their way to a Kaveri seed fad. By the harvest of 2013, which farmers would in theory use to make seed decisions for 2014, yields stabilized for smaller farmers planting Kaveri seeds, although Dr. Brent remained a high yielder (**Figure 5.10**). If farmers had been following yields alone, Dr. Brent and Jackpot should have risen to the top of new choices.

Figure 5.10: Boxplots for 2013 Fad Seed Yields Per Acre



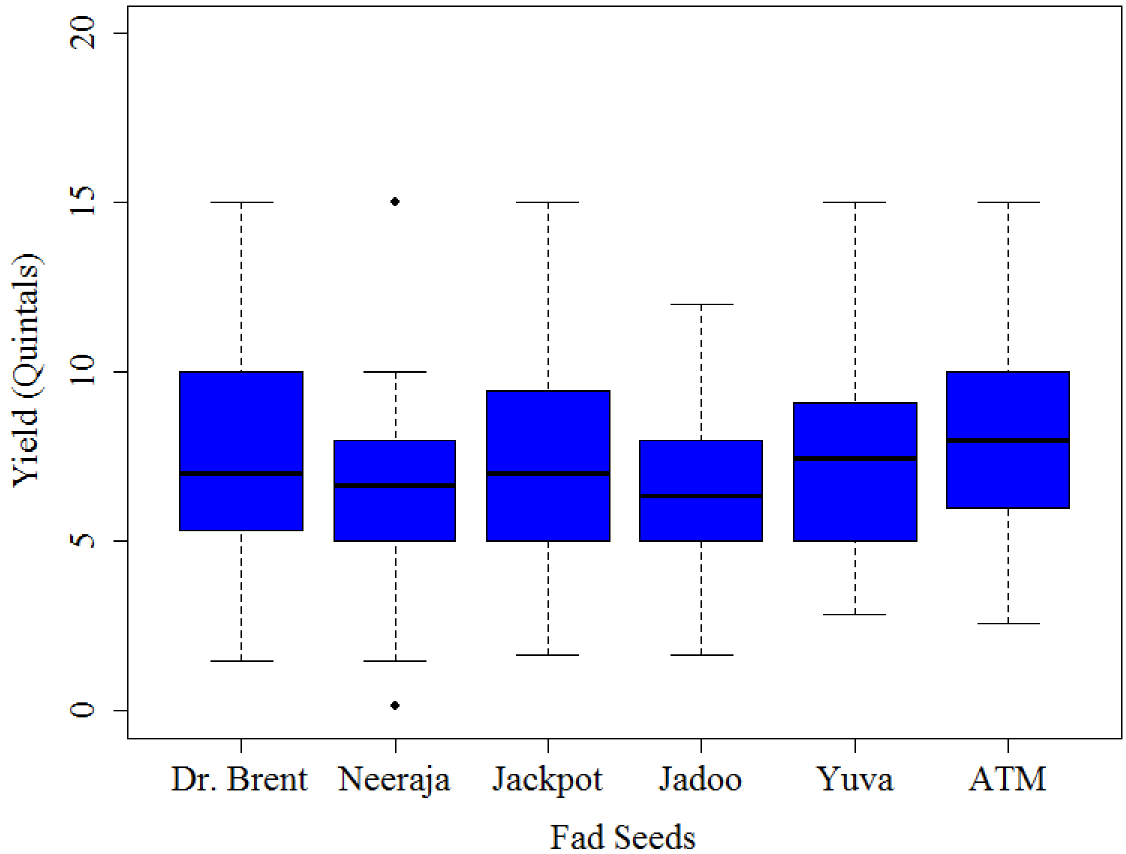
2013 Fad Seed Yield Descriptive Statistics

	Dr. Brent	Neeraja	Jackpot	Jadoo
n	64	43	51	74
Mean	7.43	6.57	6.98	6.66
SD	2.75	2.65	2.84	2.4
Minimum	1.5	.17	1.7	1.7
Maximum	15	15	15	12

Source: Flachs Farmer Survey 2012-2014.

Those seeds did not rise to the top, and from 2012-2014, farmers herded to Mahyco seeds, Kaveri seeds, and in 2014 began moving toward two new seeds, Yuva and ATM, which yielded slightly better for the 27 and 25 farmers who planted them in 2013, but well within the range of variation (**Figure 5.11**). Spurred on again by a new advertising blitz as well as a general perception that Neeraja failed (even though that seed was well within the statistical norm), Yuva and ATM rose to 107 and 62 farmer choices respectively. With no clear environmental payoff, farmers as a group switched seeds frequently and dramatically in 2012-2014. For larger farmers with more space to trial, this general uncertainty at least offered a few spaces in which they could evaluate different seeds under similar conditions. For the smallest farmers, the buzz of new seeds, which carried with it a hope for better yields, left them with the most uncertain knowledge base.

Figure 5.11: Boxplots for 2013 Fad Seed Yields



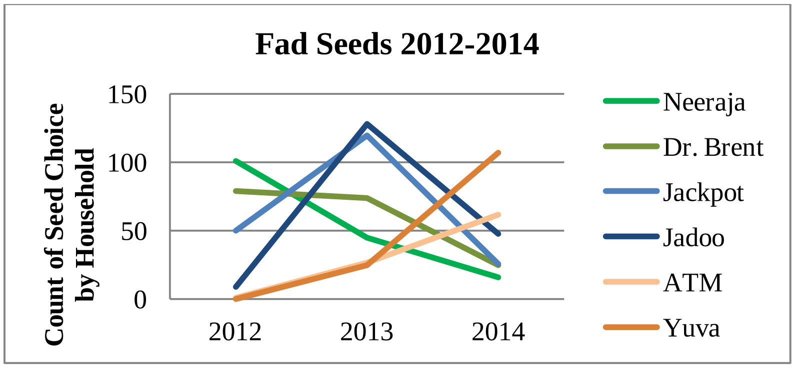
Descriptive Statistics

	Dr. Brent	Neeraja	Jackpot	Jadoo	Yuva	ATM
n	64	43	51	74	20	23
Mean	7.43	6.57	6.98	6.66	7.5	8.17
SD	2.75	2.65	2.84	2.4	2.94	3.09
Minimum	1.5	.17	1.7	1.7	2.86	2.6
Maximum	15	15	15	12	15	15

Source: Flachs Farmer Survey 2012-2014.

Aggregate seed fads are depicted above but the rise and fall of the six fad seeds 2012-2014 is summarized below (**Figure 5.12**).

Figure 5.12: Summary of Fad Seeds Planted by Household 2012-2014 with Table of Values



Seed Choice by Household by Year			
	2012	2013	2014
Neeraja	101	45	16
Dr. Brent	79	74	25
Jackpot	50	120	26
Jadoo	9	128	48
ATM	1	27	62
Yuva	0	25	107

Source: Flachs Farmer Survey 2012-2014.

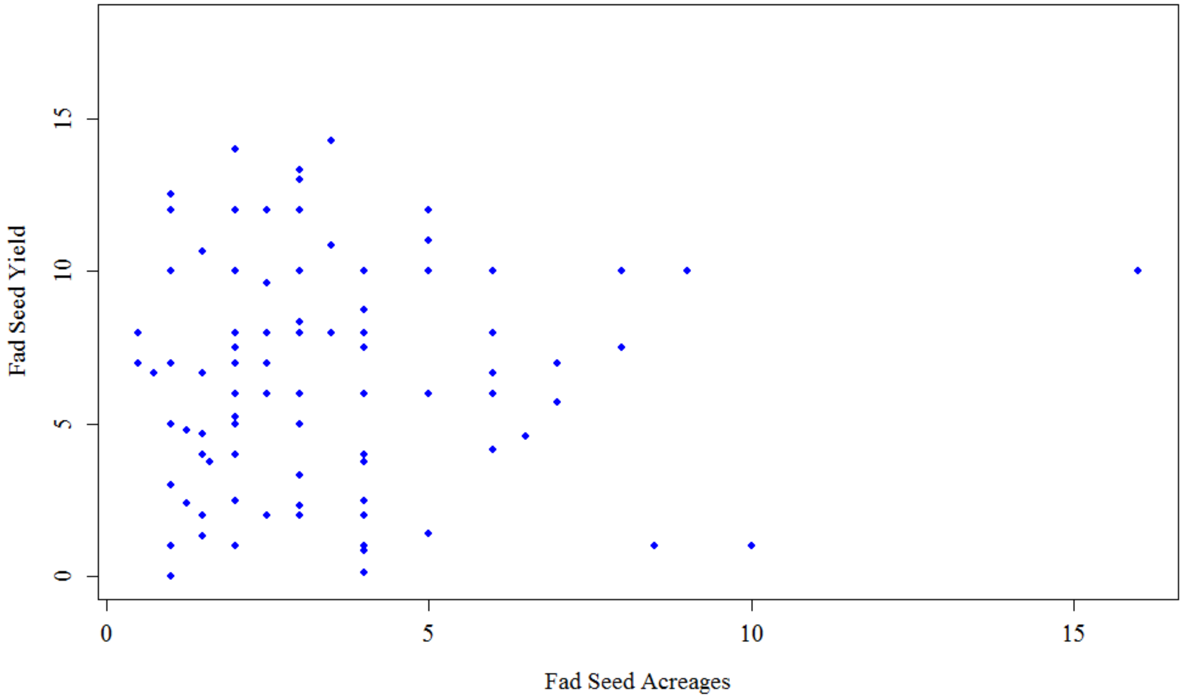
One year of popularity each, followed by steep decline – Yuva and ATM are in for a drop in popularity by 2016 if this model holds. Given their popularity, the environmental-learning question asks:

1. Were Neeraja and Dr. Brent superior to other seeds in 2011, Jackpot and Jadoo superior to other seeds in 2012, and ATM or Yuva superior to other seeds in 2013, suggesting that these seeds were just better technology?
2. Were they superior for any particular group of people, suggesting that some farmers were driving fads based on environmental feedback?
3. Were they preferred by any particular group of people, suggesting that regardless of any environmental feedback these seeds were preferred by influential people?

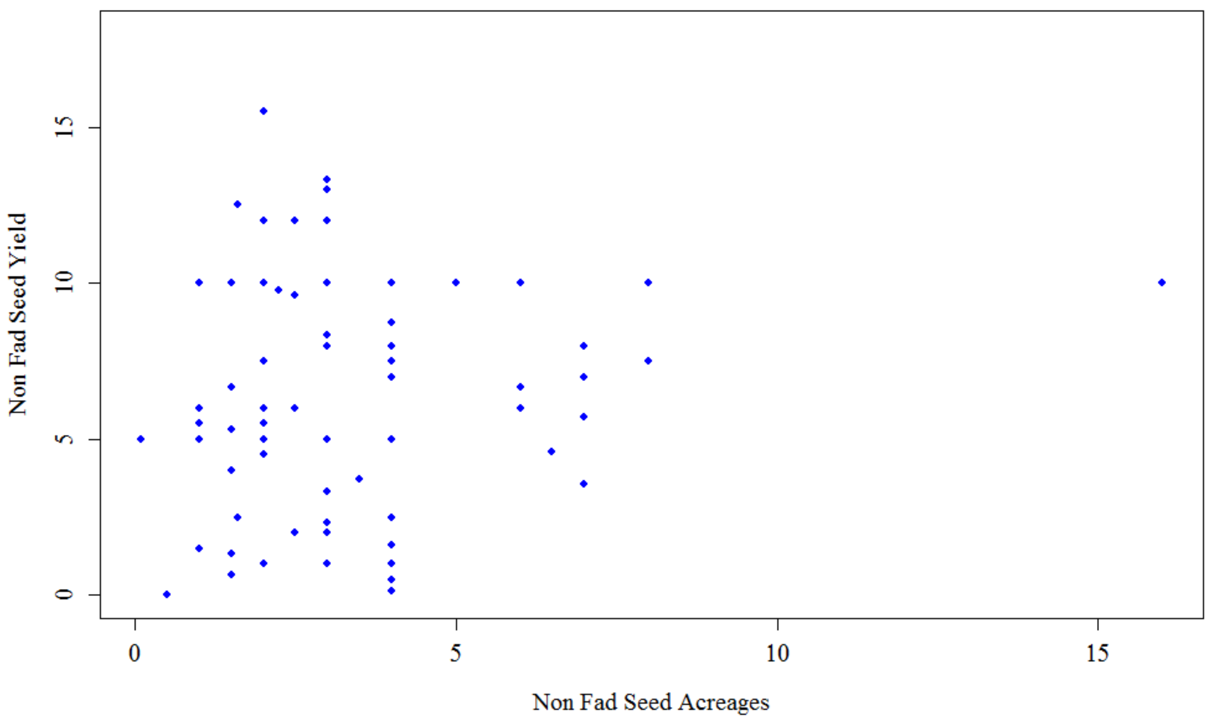
To answer the first question, I plotted the yields of the fad seeds against the amount of cotton acreage that farmers planted (**Figure 5.13**), giving a measure of the yield against the resources farmers devoted to their cotton production. If the fad seeds showed a clear yield advantage per acre to the non fad seeds, then this would imply that there was an economically rational reason to switch seeds – farmers would be environmentally learning from the village yield feedback.

Figure 5.13: Fad Seeds Yields Vs. Other Seed Yields

2011: Neeraja and Dr. Brent Vs. Others as Functions of Crop Acreage



Linear regression of Fad Seed Acreage vs. Fad seed Yield: r^2 = .000, n = 121
Mean yield = 6.95, mean crop acreage = 3.30

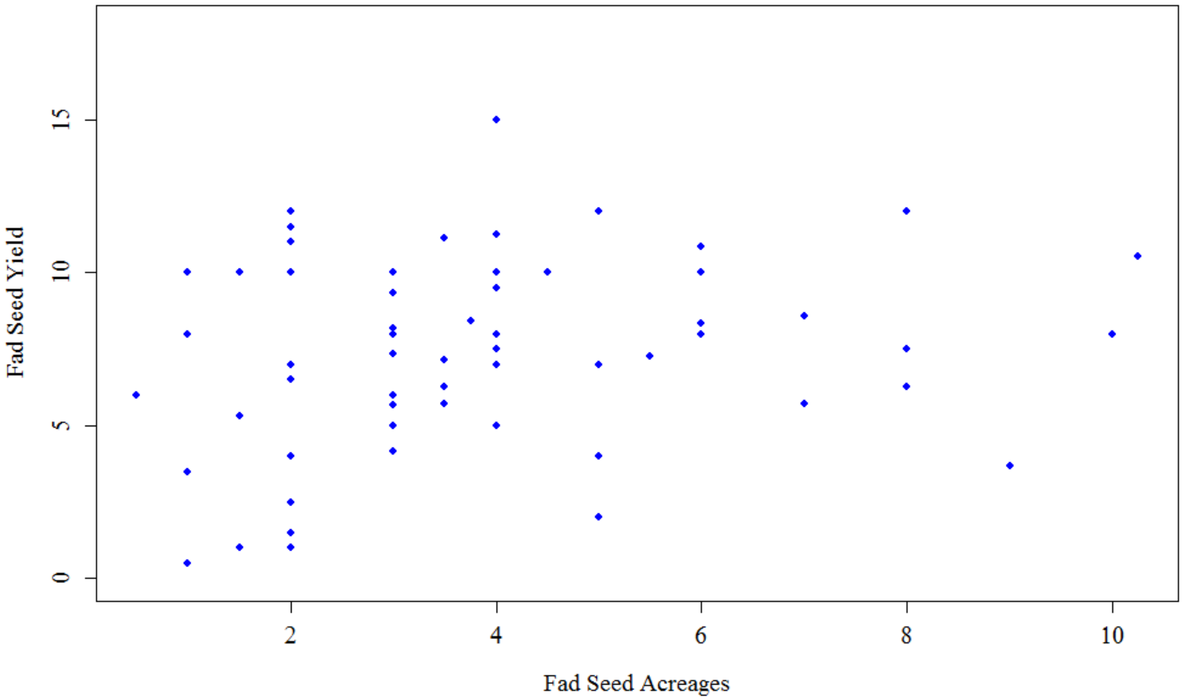


Linear regression of Non Fad Seed Acreage vs. Non Fad seed Yield: r^2 =.001, n = 80
Mean yield = 6.65, mean crop acreage = 3.24

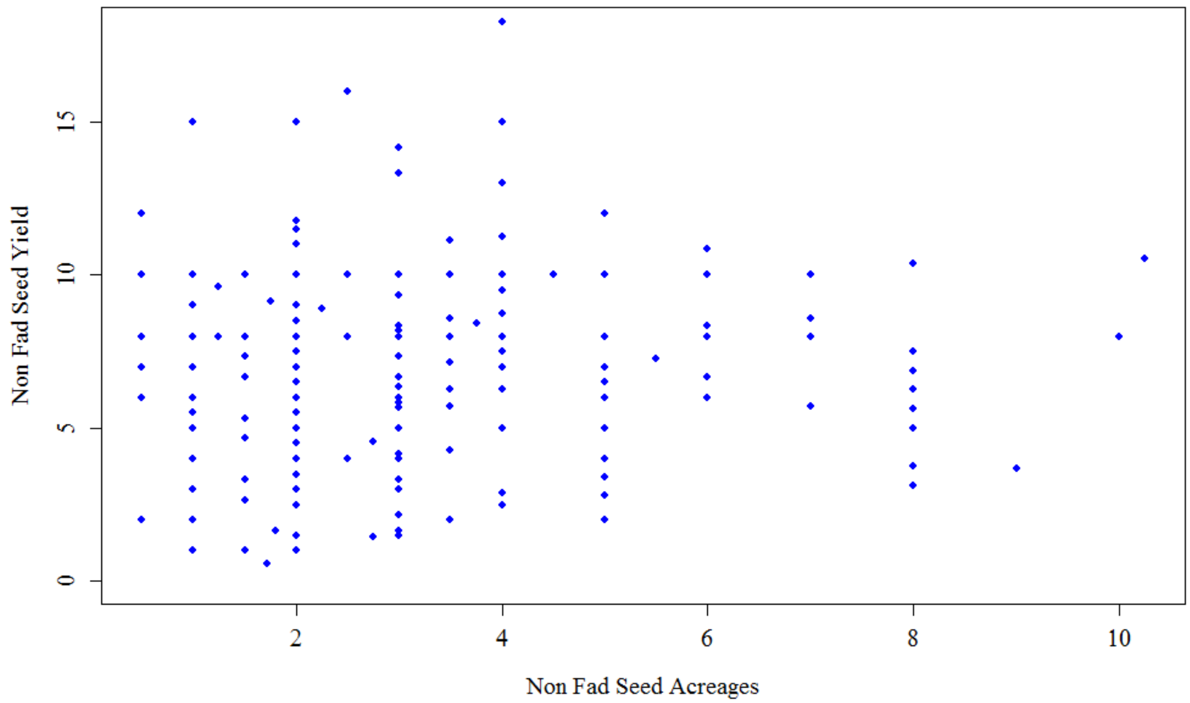
Source: Flachs Farmer Survey 2012.

Neither differences in the means of acreage (p = .426) nor yield (p = .281) were statistically significant in 2011, and the graph is clearly skewed toward a high-yielding outlier in each graph. This suggests that fad seeds were not preferred by larger or smaller farmers and did not perform better for these farmers.

2012: Jadoo and Jackpot vs. Others as Functions of Crop Acreage



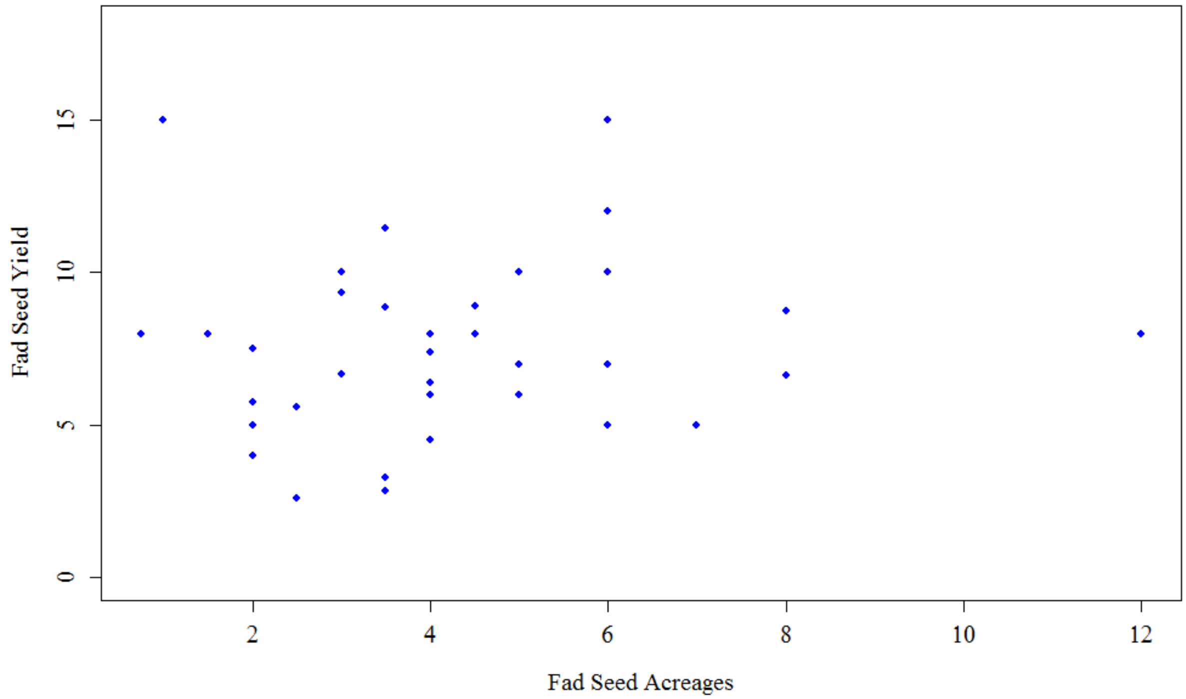
Linear regression of Fad Seed Acreage vs. Fad seed Yield: r^2 =.003, n = 69
mean yield = 7.54, mean crop acreage = 3.78



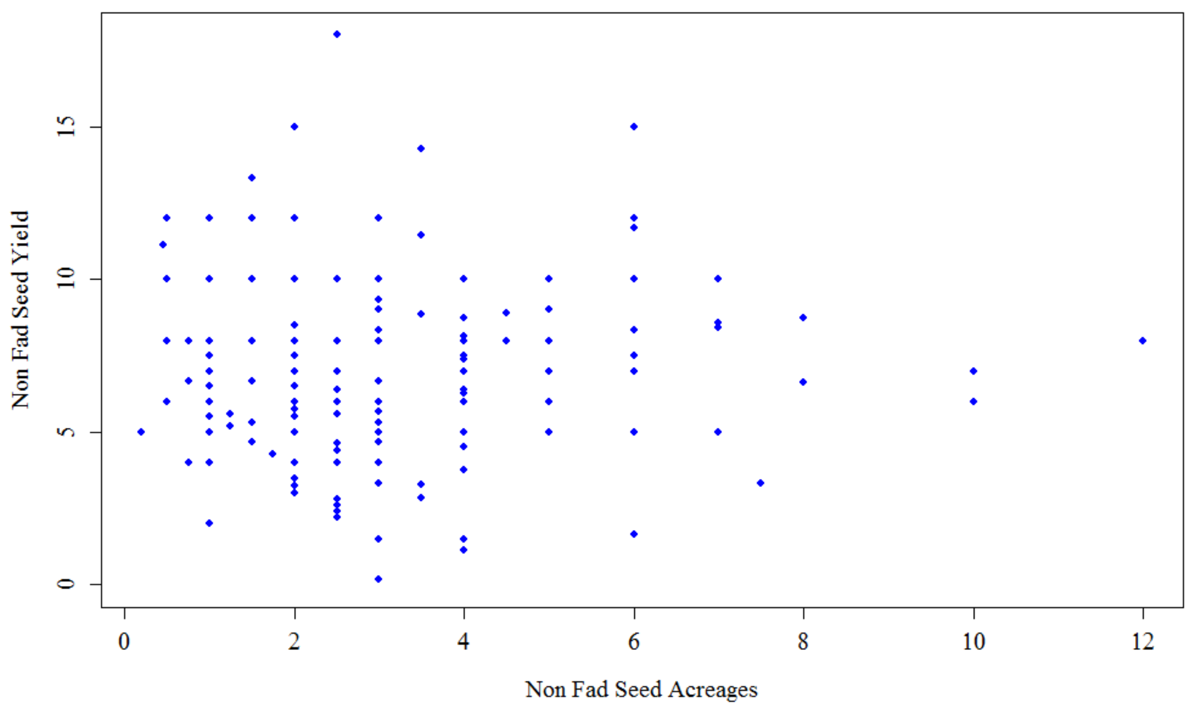
Linear regression of Non Fad Seed Acreage vs. Non Fad seed Yield: r^2 = .000, n = 272
mean yield = 7.31, mean crop acreage = 2.92
Source: Flachs Farmer Survey 2013.

Differences in acreage (p = .002) and but not yield (p = .309) were statistically significant, suggesting that larger farmers preferred fad seeds but that the fad seeds did not yield better for them.

2013: ATM and Yuva vs. Others as Functions of Crop Acreage



Linear regression of Fad Seed Acreage vs. Fad seed Yield: r^2 = .000, n = 41
mean yield = 7.68, mean crop acreage = 4.03



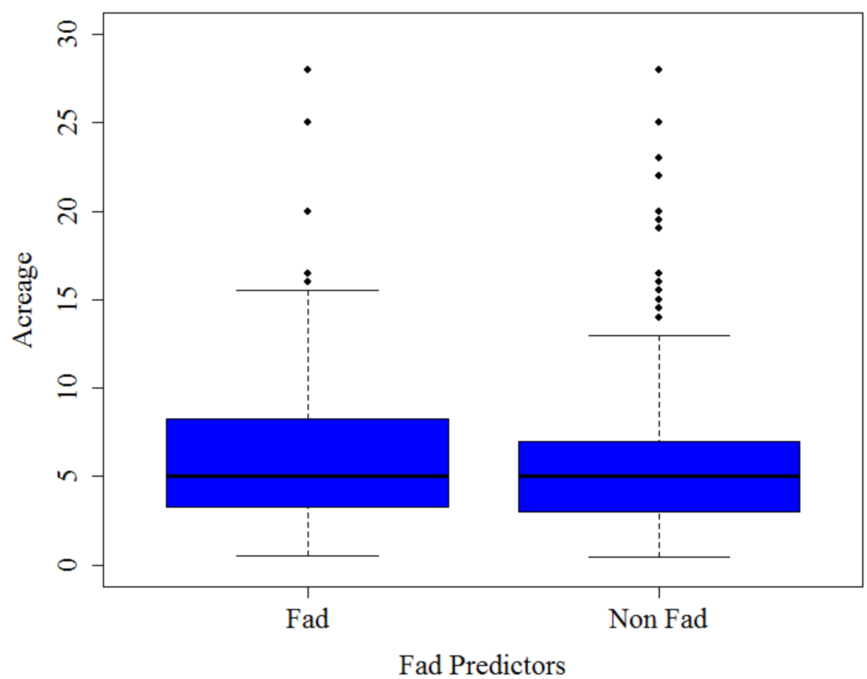
Linear regression of Non Fad Seed Acreage vs. Non Fad seed Yield: r^2 = .000, n = 215
Mean yield = 7.09, mean crop acreage = 2.97,
Source: Flachs Farmer Survey 2014.

Differences in acreage (p = .002) and but not yield (p = .121) were statistically significant, again suggesting that larger farmers preferred fad seeds but that the fad seeds did not yield better for them.

These scatterplots illuminate two important trends. First, the linear regression of the variables in these plots show a similar, and stronger pattern evidenced by seeds generally: no particular seeds or farmers have yield advantages. Second, in 2012 and 2013 farmers who planted more acres of cotton tended to plant fad seeds ahead of their sweeping popularity when compared with farmers who planted fewer cotton acres. This suggests that the farmers who are larger and who are devoting more of their time and energy to cotton farming are drumming up or sustaining buzz about fad seeds before they become popular. They create the perception that the seeds in question are of high quality. During the 2012 fad seed scarcity, this perception was further sustained by the implied authority of the seed permit system. Farmers who devote more resources and who have more resources to devote to cotton prefer with the fad seeds, but this is more indicative of the farmers than the seeds.

As the fad seeds do not appear to be higher yielding for any particular farmers or in general, the final question asks if these seeds are preferred by any group of farmers. As large farmers control more of the visual real estate in a village, they are prime candidates for fad starting. Stone (2007) has shown how these fads can be arbitrary in villages, dependent on the whims of particular influential or lucky people. But this does not explain the fad consolidation and district-level herding. That fad seeds are planted on greater acreages suggests that those farmers with more means prefer the fad seeds before they become popular. Larger, wealthier farmers who tend to belong to higher castes and thus have better working relationships with shops and extension agents plant a large number of fad seeds that do well enough and their choices are then emulated in the actual fad year, by which time the original fad seed planters have moved on. Boxplots showing the planting choices of farmers in 2012 and 2013 show that larger farmers are more likely to plant fad seeds in the year before they become popular (**Figure 5.14**) and that size has no impact on whether or not farmers are likely to plant the fad seeds in the year of their popularity (**Figure 5.15**).

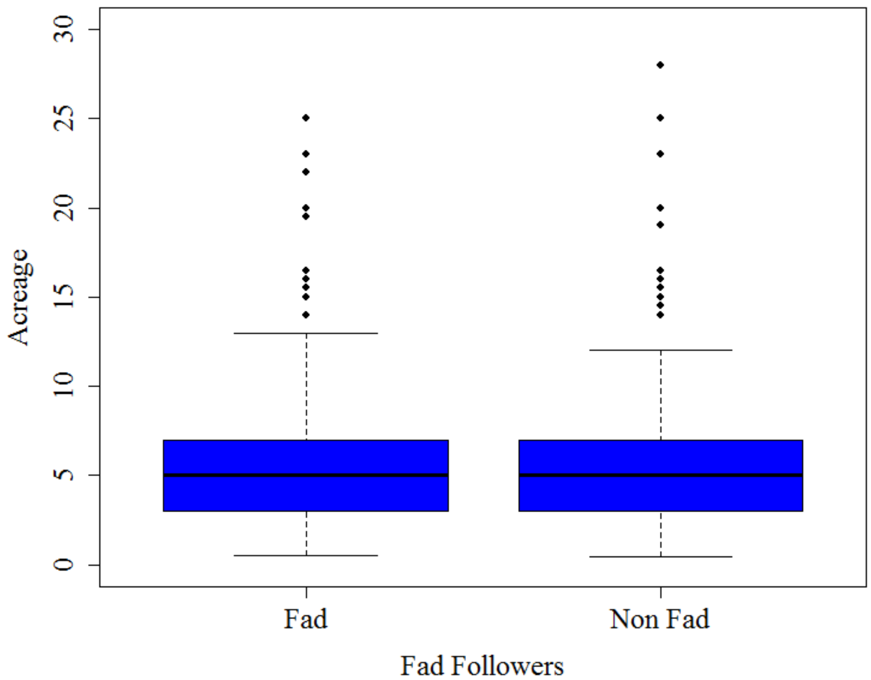
Figure 5.14: Boxplots Comparing Holdings Size of Fad and Non Fad Planting Farmers in the Year Before They Become Popular



Descriptive Statistics

	Fad Farmers	Non Fad Farmers
n	113	1395
Mean	6.58	5.69
SD	5.00	3.83
Minimum	.50	.45
Maximum	28	28

A t-test of the differences in total acreages between fad and non fad predicting planting farmers determined that the differences are statistically significant (p = .035), suggesting that larger farmers were more likely to plant fad seeds in the year before they become popular. Source: Flachs Farmer Survey 2012-2014.



Descriptive Statistics

	Fad Farmers	Non Fad Farmers
n	599	909
Mean	5.63	5.84
SD	3.82	4.02
Minimum	.50	.45
Maximum	25	28

A t-test of the differences in total acreages between fad and non fad planting farmers in the year of the fad seed's popularity determined that the differences are not statistically significant (p = .854), suggesting that larger farmers were not more likely to plant fad seeds in the year of their popularity. Source: Flachs Farmer Survey 2012-2014.

These slight tendencies in a context where larger farmers plant more seeds around the village and where farmers with more land devoted to cotton prefer fad seeds should be seen as evidence that larger, and especially the largest farmers have undue influence in the seed choices of their neighbors. That these seeds are not demonstrably better is beside the point because a combination of social advantages allows the largest farmers reduce their growing risk while trialing new seeds. These large farmers also have an undue influence on their neighbors not just because they control more seeds, but because they are looked to in times of agricultural uncertainty and help to strengthen the ‘buzz’ surrounding each seed. *Pedda* farmers often hire their neighbors and lower caste, tribal, or poorer village members to labor on their farms. While working on these fields, the smaller farmers see the seed choices of their *pedda* neighbors and often emulate them. Seed shop owners and extension agents speak more freely and easily with these farmers than with lower caste, poorer farmers. As wealthier and more mobile village members, the *pedda* farmers sometimes even buy seeds for their laborers directly, who only ask that these larger farmers bring an extra packet of whatever seed they think is best.

Size and connection to institutional resources through extension programs are correlates or standins for a variety of social and economic opportunity that allows not better trialing but better influence. Large farmers can press their advantage by talking with shop and university experts to get the latest gossip and the most encouraging advice. Smaller farmers, from more disenfranchised castes and with less income have less information coming in and less ability to improve their situation. These social differences compound the existing problems in the cotton market, leading the most marginal farmers with the fewest opportunities to learn which seed is best while the farmers best suited to a competitive and commodity-driven agriculture kick off seed fads that they themselves become swept up in.

In this section I have argued that larger farmers have better access to seed knowledge and prefer fad seeds before they become popular, helping to push farmers as a whole toward seed herding. The short-lived fads affect all farmers, as demonstrated by their presence on the district level. For the smaller farmers, who labor on large farms, for whom investment is riskier, and who plant fewer cotton seeds, the quick switches indicated by the seed fad patterns are more dire because they indicate that these farmers are at the whim of marketing and luck. Professing to follow their neighbors, and having their neighbors be better predictors of their seed choices than themselves, even when they outperform those neighbors with different seeds, farmers in fact disproportionately choose to plant seeds that their rich neighbors prefer. This social emulation leads the smallest, most marginal farmers adrift in the learning process. Large farmers too are caught in the fads, and there does not appear to be a strong, direct link between size and any single agricultural or social factor. But the largest farmers benefit from a loose collection of social advantages that, combined, reduce their risk during seed uncertainties. Because of their larger land holdings, they can try out new seeds alongside seeds that they know work, and more of the visual cotton landscape is dominated by their social peers, who have comparable resources and thus serve as good comparisons.

Conclusion

This chapter has argued that the agricultural deskilling experienced by GM cotton farmers in Telangana has affected different farmers in different ways. Larger farmers do not enjoy particular advantages in yield, spray payoff, lining payoff, knowledge about which seeds might be best, or relevant information about the fad seeds. In many respects they are just as adrift, misled by the same patterns of inconsistency, uncrecognizability, and rapid change that flummox the rest of the village and exacerbate the ongoing deskilling that Stone (2007) describes. The general trend of seed buying, evidenced by fads, herding, and the tendency that field neighbors are better predictors of future seed choices than the farmers themselves (Shaffer and Flachs 2014), shows that farmers as a whole have no environmental, first-hand experience on which to base their seed choices. Yet, expanding Stone's original deskilling metaphor, I would argue that the largest farmers have influenced these fads and are sheltered from the most devastating and predatory effects of the technological uncertainty that these fads bring.

Importantly, no farmers seem to be regularly conducting effective or reliable trials and no farmers seem to be benefitting from environmental learning. The *pedda* farmers are simply better at working with the new managers of cotton knowledge.

When seeds become a commodity, and when that commodity becomes difficult to distinguish, farmers encounter a space social psychologists and behavioral economists call choice overload (Chernev, Böckenholt, and Goodman 2015; Scheibehenne, Greifeneder, and Todd 2010). This is a problematic term, as it is hard to pin down exactly how many choices are overwhelming, but it describes the tendency for more options to lead to fewer actual purchases and less satisfaction with them. Studies of choice overload question if more is actually better. As cotton choices have increased over the past decade of GM planting, the inability to reliably trial seeds, undue influence of people who have no documented advantage, and general uncertainty about seeds have similarly increased. In the parlance of choice overload thoerists, more seed product options led to more poorly informed and anxiety-ridden decisions. In one influential study, Iyengar and Lepper (2000) asked grocery store shoppers, Stanford undergraduates, and Columbia undergraduates to choose between a wide or narrow field of jams, essay topics, and chocolates respectively. The results were surprising: 30% of the jam shoppers bought jam when presented with six choices, compared to 3% presented with an array of 24 jams; Stanford psychology undergraduates scored better and were more likely to complete the essay assignment when given fewer options; and the Columbia students were four times more likely to take chocolate rather than a comparable cash prize when presented with six rather than 30 chocolate options. Unlike cotton seed choices, food and essays are low-stakes decisions, but Iyengar et al. (2004) also examined choice overload in American 401(k) plans. Even though a 401(k) can make or break an employee’s retirement, participation dropped as employees were offered more plan offerings. Among people who had invested with the management company Vanguard, as plans offered more funds, people were less likely to contribute: every 10 funds added was associated with 1.5% to 2% drop in participation.

Among social psychologists and consumer scientists, the problem with choice overload is a procrastination or lack of choice that would prevent a product from being consumed or the demoralization and regret associated with making an incorrect choice. Most cotton farmers do not simply fail to buy cotton because they are overwhelmed, although many in 2014 chose to plant maize as a result of projected low prices and late monsoon rains. Because agriculture is the source of their livelihood, choice overload does not stop farmers from buying seeds. However, choice overload, in combination with rapid change and a lack of differentiation, helps create an intense anxiety around seed choice as well as sense of regret or profound relief in having chosen correctly. Choice overload does not happen in all cases of large and confusing markets – the supermarket where Iyengar and Lepper conducted their initial study itself offered 250 different varieties of mustard, 75 different varieties of olive oil, and over 300 varieties of jam. Rather, meta-analyses indicated that it is prevalent when the decision is high-stakes, when consumers have problems differentiating between products, when a clearly superior product did not exist, when the intended use for the product was difficult and complex, and when it was difficult to clearly compare (I might use the word trial) similar products (Chernev, Böckenholt, and Goodman 2015; Scheibehenne, Greifeneder, and Todd 2010). Each of these factors is true in the cotton market. In their original study, Iyengar and Lepper suggest that the anxieties of choice are exacerbated when truly informed decisions are difficult and the costs of making the wrong choice, or even believing that one has made the wrong choice, are higher (Iyengar and Lepper 2000:1004). Indeed, like the farmers who shrug and ask shops or *pedda* farmers what they think is best, the authors note that "the more choosers perceive their choice-making task to necessitate expert information, the more they may be inclined not to choose, and further, they may even surrender the choice to someone else – presumably more expert" (Iyengar and Lepper 2000:1004). Seeds differ from these products, even from important products like retirement plans in important ways. Cotton farmers who planted hybrids and other GM seeds before the study period certainly had some experiences, knowledge, and preferences that were relevant to their decisions, even when they could not act on them. Also, choice overload is often cited to explain non-consumption, which does not apply to the situation with Telangana farmers, who have adopted Bt cotton seeds in droves. However, the anxieties of purchasing, the unreliability of information, and the deference to experts all ring true for cotton-seed decisions. Furthermore, these studies suggest that cotton's great number of possible brands and few means of differentiating them provide the right conditions for farmers to feel exasperated and even overloaded.

In numerous contexts, watershed studies in the diffusion of technologies have noticed similar trends: wealthier, larger, more cosmopolitan farmers on better terms with extension agents instigated the trend to plant hybrid corn in post-depression Iowa (Ryan and Gross 1943); metastudies of the diffusion of innovations show that early adopters tend to have strong connections to power and influence (Rogers 2003); *Pedda* farmers were and continue to be targeted by new seed campaigns in Warangal (Stone 2007). Less understood is what happens after the diffusion has spread. Like any commodity, GM seeds have been socially recognized and made relevant to their farmer users, but through that transformation, GM seeds were dissociated from intimate knowledge about their production. Large farmers were able to substitute this knowledge for friendly relationships with seed experts and some minimal trialing.

They may not have been able to restart the learning process but they are able to cushion the blow somewhat. In the new world of seeds reduced to a brand name, farmers have to learn to be different kind of consumers if they will generate knowledge about GM cotton. Those who simply plant what is popular have only hearsay and marketing to rely on, and will remain at the highest risk for financial and agricultural ruin. This is a seed market suited for the needs and abilities of larger, richer, better connected farmers.

To call GM seed technologies sustainable, either because GM seeds raised yields or decreasing sprays on a national level (Qaim 2010; Kouser and Qaim 2011; Kranthi 2012) sidesteps the anthropological question: are these technologies sustainable in the sense that people know how to and choose to use them? The externalization of knowledge from the farm field to the managerial office has been stratified by wealth and land holdings among conventional farmers. These economic features are associated with caste and social status in rural Telangana. The large, socially important *pedda* farmers disproportionately plant more of the total seed makeup of the village: when farmers claim to be following good production in a neighbor's field, they are not merely following the results of a larger farmer with more resources that one would expect to produce better. The seed choices they are capable of observing are themselves bottlenecked by the seeds that *pedda* farmers prefer. In other cases, opportunistic brokers or large farmers simply sell the seeds they bought to small and marginalized farmers. The original marketing thrust of GM seeds, which assumed that farmers would not need to do anything different to successfully grow cotton (Thaindian News 2008), appears to be false as demonstrated by the inability of most farmers to trial and assess the new technology in the time required to use their environmental learning to make seed decisions. Given that intimate local ecological knowledge has been shown to be crucial for sustainable endeavors, the GM seed market appears to be eroding, rather than building local efforts at sustainability. That the farmers driving village-level social learning appear to be the wealthiest, highest-status farmers rebuts claims that GM crops are a “pro-poor” technology (Qaim 2010).

If the question of agricultural sustainability rests as much in the knowledge of farmer-practitioners than in the technology itself, more attention must be paid to the learning processes of GM farmers. As a function of their social connections to extension services or their wealth, some farmers are better able to balance didactic, social, and environmental learning. As I have argued, environmental learning, the ability to trial various technologies in your own field and respond to the results, is the necessary missing building block of knowledge in GM cotton farmers who are being deskilled. Whether emulating the choices of larger neighbors or deferring to experts in a choice overload environment, this analysis argues that knowledge is contingent upon farmers’ responses to agricultural risk. A missed chance taken on a bad seed can ruin a GM farmer.

Just as this chapter discussed the conditions that lead to deskilling and the ways in which some farmers are able to avoid that trap, the following chapter discusses the ways that knowledge is more persistent on rice paddies. The same cotton-growing farmers who follow seed fads behave very differently and more in line with a balanced approach to environmental, social, and didactic learning when choosing and evaluating their rice seeds. This has much to do with inherent agricultural qualities of rice, but it also rests on the different ways that farmers buy, sell, and talk about rice. Rice knowledge too is socially mediated, but in different and in a much calmer market. Rice’s lower stakes, reduced choices, and greater inherent opportunities for environmental learning allow the same farmers to better develop and use agricultural skill.

Chapter 6: Persistent Knowledge in Rice Fields

Sitting on the stoop of a *thanda* house surrounded by burlap sacks of rice, I am receiving a lesson in seed knowledge that I never receive when I ask about cotton. "The seed works for only two years, because after that the production starts to drop and the seeds become *kalthi* (rotten and less productive)," Chandya explains. "Smart farmers keep the harvest and sell when the price is high if they can." Are there differences between rice that you see in the field that determines what is sold, eaten, and saved, I ask? I'm trying to get at variations in the plant's growth habit, color, or some other outward evidence that it would be suitable for saving, but he ignores my question in favor of a more meaningful discussion of the seeds themselves. "There's no difference in the field or after it has been winnowed between seed for selling, eating, and saving. All is bagged together. The difference is in the *talu* (empty husks without large starch grains) and *beriki* (seeds of other varieties, cracked rice that will not germinate, or seeds that otherwise appear different as plants or seed grains), as those seeds can't be replanted. Choose how many [bags of rice] you'll save first, sell the rest, and choose planting rice from the cooking stock. Any that are cracked are bad for both cooking and planting." Rice seed has history and personality, in part because it passes through so many different stages and can be touched and examined at each. Cotton seed is sterile by comparison, arriving in sealed packages, colored with an imidicloprid[12] treatment that protects the seed from hungry insects, and altogether dissociated from the farmers who produced it. While rice yields[13] and returns on investment are of course important, farmers have a distinctly more complicated relationship with rice seed than they have with cotton, which is always reducible to its commodity form.

[12] Imidacloprid is a neonicitinoid poison applied to cotton seeds, affect insects that eat young cotton seeds before they have time to develop much defensive GM Bt toxins or naturally occurring gossypol.

[13] Rice yield is measured in ~50 kg bags

Building on Stone's (2007) explanation of agricultural deskilling, the previous chapter showed that cotton seeds provide little meaningful environmental feedback for any aspect of the planting regime. Even when farmers conduct experiments, their seed choices devolve into what Stone and others call conformist bias. Grown by farmers who are agriculturally deskilled by cotton seeds' unrecognizability, inconsistency, and accelerating rate of change (Stone 2007), cotton agriculture is additionally stymied by socioeconomic demands in the anarchic market: an overbearing profit motive in cash-cropping, brand saturation, and anxiety over lost opportunity costs. Ultimately, chapter five showed that there is no relationship between yields and any aspect of the environmental learning process, but that experts and *pedda* farmers can jumpstart or sustain new seed fads. However, rice, the other key crop of Bt cotton planting farmers, gives farmers more opportunities to build skill.

I argue in this chapter that agricultural knowledge is built differently with rice because choices are fewer, seeds are better known, the seeds change more gradually, and farmers generally have the flexibility to eat, save, or sell the product depending on the circumstances. Farmer recall is relatively better with rice seed choices and farmers on average tend to have a stronger knowledge base and personal planting history with their rice seeds. Unlike their cotton cash crop, yield is not the overwhelming consideration with rice. Because rice can also be eaten it is viewed by many farmers as a safer investment requiring a lower monetary commitment. Unlike a cotton harvest, rice harvests can be 'good enough' in the sense that an overwhelming yield in a neighbor's field will not necessarily sway a farmer looking for a variety of phenotypic qualities that determine suitability for saving, price at market, taste, and suitability for the farmers' field. Although some farmers are turning to higher-investment, higher-return hybrid seeds or hybrid seed production, the vast majority of seed choices are based on more reliable, tested open pollinated varieties (OPVs) that farmers value for their reliability.

Rice is a more easily trialable technology than cotton because it lacks the unrecognizability, fast-paced change, and inconsistency Stone (2007) attributes to cotton. Rice is not a fully commodified technology, and furthermore the knowledge required to manage rice on Telangana fields is neither commodified nor the purview of expert authorities. Additionally, the social politics of rice knowledge has a different reward structure than the heavy emphasis on yield (as a proxy for net return) and opportunity cost seen in cotton agriculture. Large farmers, shops, and extension agents have less influence on farmers' choice of rice seed varieties. The one exception to this comes in the form of rice that resembles cotton: hybrid rice. This rice is rarely eaten, knowledge of its management is the purview of outside experts, early adopters are selected by salesmen for their social influence, farmers see it as a means to an end defined by yields and heavy investment, and they have relatively little knowledge about what it is. Like American farmers of the early 20th century who surrendered various aspects of the seed production process to private and public hybrid seed breeders (Fitzgerald 1993; Kloppenburg 2004), farmers are learning less about the environmental qualities of hybrid rice itself and learning more about how to buy products and follow expert instructions. Both this chapter and the previous chapter draw heavily on quantitative data from seed surveys that illustrate consensus on agronomic properties of seeds, data on farmers' experiments in the number of seeds planted, village level responses to yields, and comparisons of the rise and fall of different fad cotton seeds against the more relatively stable rice seeds. I will begin by demonstrating that rice knowledge is more locally nuanced than cotton knowledge, reflecting a greater degree of environmental learning.

Rice and Nuanced Local Knowledge

As expressed in focus groups throughout the Warangal district villages, the logic of cotton production is simple: yield. Farmers describe two phenotypic forms in cotton, each of which can bring a high yield. In one variation, increased branching leads the plant to produce a higher quantity of smaller bolls, with the upshot that the larger quantity will compensate for the size. The other variant takes the opposite approach, producing fewer but larger bolls that house a heavier and thus pricier seed cotton. More occasionally farmers mention qualities related to management such as resistance to sucking pests or increased height to facilitate denser planting. For all farmers' transient insistence that particular brands will be superior, they are watching for yield, nervously subtracting labor, input costs, market price at the time of sale, and uncooperative weather from their future profits. Within this calculus, the most visible factor is the yield. If the cotton is growing without sprouting, add fertilizer; if the fertilizer makes the leaves wilt, add water; if insects eat away the bolls, spray pesticides. The seed is only useful insofar as it can produce a good yield, and farmers must protect this seed investment if they hope to gain any profit from their labor.

Knowledge is more nuanced in rice, in the sense that it has finer and more agreed-upon distinctions, as I will show below. Furthermore, farmers develop and investigate these distinctions by handling rice directly, making this knowledge tactile. Farmers distinguish rice by grain thickness and taste, plant it according to longer-term, non-faddish patterns, use relatively fewer chemical inputs, and employ more labor in the planting, harvesting, and saving process that requires farmers to touch and inspect their crop. Rice is additionally a more stable choice, as there are fewer rice seed choices to make, private companies control little of the market, and comparatively fewer farmers opt to plant rice seeds with which they have no personal experience. Rice can be eaten, stored, sold, and saved. Each aspect of this management requires a set of specific local knowledge. Cotton extension scientists and shop owners with whom they are friendly are quick to point out that certain seed brands resist particular insects or have a particular growth habit conducive to high yields – not so the farmers themselves.

Within rice choices, farmers generally agree on a particular OPV's growth habits and ecological tendencies. Because rice can be and often is saved, farmers must also look out for *beriki* and *talu*. When rice seeds are carefully inspected before replanting, farmers endeavor to catch these dud seeds. Unlike the cotton seeds, farmers run their hands through rice seeds, noting variation and damage. Planting one *beriki* seed will produce uneven grains that are less desirable to buyers in seed markets. Thus, by the third replanting, many farmers opt to buy new seeds rather than continue to save and continue compounding the risk of errant seeds. However, unlike the changing cotton brands, focus groups of farmers insist that the same rice seeds are always good. "Year after year you can rely on the same ones…but in cotton the companies become lazy cheaters and every year you have to switch to new seeds. After they become popular once the companies just stop trying and the seeds are terrible."

The most obvious key difference is that between "thick" and "thin" rice varieties. Thickness refers to grain size and although it is a scientific breeder's category it designates several qualities in Telangana farmers' taxonomy. Thick rice, which includes popular varieties MTU 1001[14], MTU 1010, and JGL-384, has a thicker and shorter grain, is more resistant to pests and disease, takes less time to mature, is better suited to drier *rabi* (December-March) conditions, has a greater yield, and tastes bad. These are contrasted with thin rice, including popular varieties Warangal 14, Warangal 32100, JGL-1798, and BPT 5204, which have thinner

[14] For public OPV rice varieties, the first three letters indicate the rice's breeding station and the numbers after the dash indicate the particular variety strain.

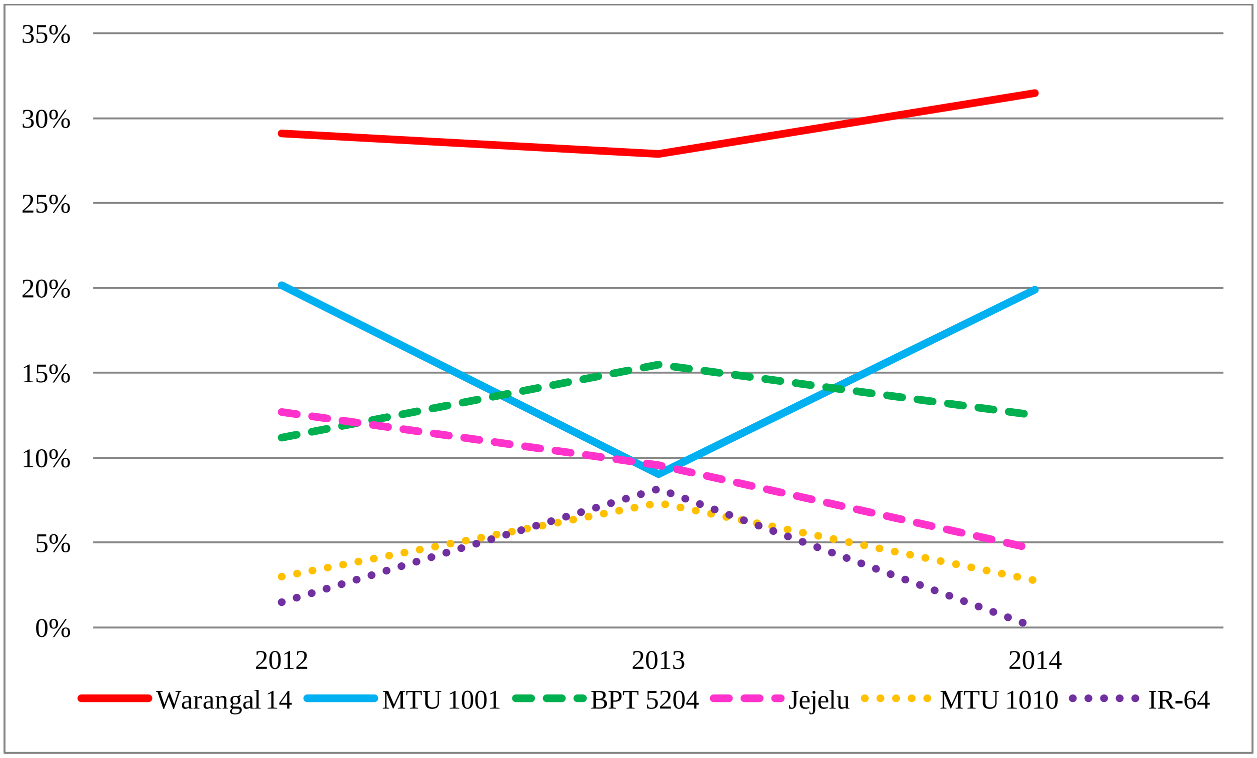
and longer grains but require more delicate care, more time to mature, are better suited to the rainy *kharif* season (late June - November), and yield fewer, tastier grains. During a lunchtime interview with a farmer who was eating MTU 1001, he pointed at it with disgust, saying, "if we eat this, we'll be full all day. With thin rice we'll be hungry again at meal time *and* the taste will be better. 1001 is just substance." "1001 is not even fit for cows to eat," scoffed another. This is a partly social attitude as well. MTU 1001 and MTU 1010 are purchased by the government and sold for Rs 1 per kilogram to the poorest members of society who can produce a ration identification card. Few farmers jump at the chance to eat or celebrate such poverty foods. Although the thicker rices tend to yield higher and suffer fewer insect attacks, farmers prefer to sell this rice and buy thin rice at the market. "Nowadays the market preference is for medium slender grains," confirmed Indian Council of Agricultural Research (ICAR) senior scientist LV Srirama Rao. "Unlike in the past people used to take coarse grains, the little bold grains. Now people are not preferring the bold grains, there is a lot of preference for the medium slender grains, that is, BPT 5204 or JGL types." The importance of keeping up with farmer desires for thinner seeds is not lost on Srirama Rao, who helps direct extension and breeding programs throughout South India:

> When we are selecting material we generally go for the physical appearance, like whether it is medium slender or not. And then we go for the quality analysis. [We select] parameters like length and width and then LV ratio. The LV ratio, what does it generally talk about? The shape of the grain. Whether it is a long slender grain or a long bold grain or a medium slender grain or a medium bold grain or short slender or short bold. Gone are the days people used to eat the medium bold or the long bold. Now everybody prefers medium slender grain, the fine grain varieties, which are having lot of demand in the market because consumer wants these varieties. So the breeding programs are also tuned in such a way to get these qualities incorporated into the new varieties that are developed.

Thin rices have an additional advantage in taste. Not only are they culturally understood to be better because they are thinner, many varieties also have a greater proporition of oil and fat. BPT 5204, first developed in 1986, has maintained years of popularity (Jonathan 2010) because of its reliability and taste despite lower yields and susceptibility to a variety of pests. The need to balance pests, taste, and yield leads farmers to more carefully evaluate the differences between different rice seeds while the diminished rice seed options mean that, unlike cotton, there are fewer opportunity costs for choosing rice seeds. In one interview, a smaller farmer more concerned with price than taste advised me that one should always go for the thick rices as the overall yield is better and thus the price is improved. Thin rices, he explained, also take longer to mature and bear harvest, so farmers can replant fields more often with thicker seeds. The same man did not distinguish between cottons except to say that he heard that one brand, Brahma, had small bolls and that he would not be planting it.

In the previous chapter, I critically examined seed trials among cotton farmers because the farmers did not distinguish between seeds well, did not learn from their trials when they did distinguish seeds, and over-relied on cues from the largest farmers who dominated the village landscape. As an aggregate, farmers choose cotton seeds in accordance with spiky, fad-like patterns. This is notable over the long term as well as during the 2012-2014 study period. However, rice choices manifest differently (**Figure 6.1**).

Figure 6.1: Popular Rice Seed Choice Patterns 2012-2014 as a Percentage of Households Choosing the Seed (varieties accounting for 1% or more of sample)



Source: Flachs Farmer Survey 2012-2014.

This figure shows *kharif* rice seed choices for the same Warangal district and Matepalle village farmers who grow Bt cotton (n = 329 choices). Unlike cotton seed buying patterns, the same rice seeds remain popular throughout the sample, their market shares are less dramatic than those seen at the height of cotton fads, and their waves of popularity manifest as gentle ebbs and flows rather than dramatic peaks and valleys. Warangal 14, a variety released in 2005 from the Warangal agricultural research station, combines the taste and slender grain benefits of popular parent line BPT 5204 with an improved resistance to pests and viruses. This rice, benefitting from taste, hardiness, and local breeding has maintained a steady popularity in the research area.

Choice overload, an anxiety-producing overabundance of choices in the marketplace with no good way to differentiate between them (Scheibehenne, Greifeneder, and Todd 2010; Iyengar and Lepper 2000; Chernev, Böckenholt, and Goodman 2015), may be detrimental to cotton decision-making. But rice's buying patterns suggest a greater certainty in tandem with the greater knowledge base and more complicated calculus that defines rice seed decision-making. Part of the explanation for this lies in that rice choices are less overloaded.

In focus groups, farmers can recount the waves of cotton seed fads, listing each seed's promise and ultimate failure. "Okay," I asked one such group. "This year Warangal 14 and MTU 1001 are the popular rice seeds. What about last year?" The farmers thought this was a silly question:

F1: "That rainy season it was Warangal 14 and MTU 1001".

A: before?

F1: "After that we were using the same, some vijaymsuri (BPT 5204) too".
F2: "Then some vijaymasuri, a little bit".
F3: "Only 1001 gives a good yield when compared to others. I got 40 bags for an acre…Even if (insect pests) attack, you'll get something".

A: Before that?

F2: "Oh, common seeds, some JGL."
F3: "Our batch used to grow this kichidi samba in the village. About 15 or 20 years back when NTR (N.T. Rama Rao) was Chief Minister."

A: For these 20 years its been W14 and 1001?

F1: "Yeah, these same".

Thus stability characterizes not only the few years that I have been working in the region but also farmers' recent memory. Where farmers will differentiate numerous inconsistent aspects of cotton seeds that essentially reduce to rumors of good yield, the same farmers shrug that "all [rice seeds] are the same. There is not much difference between types." "But," I asked, A: I have one small doubt[15]. Every year new seed, new seed, new seed is famous. But every year the same rice is famous. Why are these different?

F1: "There are two to three favorite seed choices for farmers as far as rice is concerned, so we'll be choosing on those particular varieties most."
F2: "We do not rush to change the crop. The same kind of [consistent] yielding [that we get rice] is not there in cotton."

At this point crosstalk broke out and a research assistant who was helping run the focus group clarified the chatter for me: "They say, the *digubati* (yield) is good in rice all the time. In cotton it's not so reliable." Cotton's uncertain rewards and farmers' laserlike focus on yield ensure that cotton choices will always be tinged with anxiety in a way that is irrelevant to rice choices.

Nationally, cotton planters have more than a thousand possible options through the private market. Of these options farmers in my six sample villages planted 102 during the 2012-2014 seasons. Based on my experience in Warangal seed shops, they likely saw at least three hundred varieties at any given city shop in any given year. Rice varieties do not have to be approved for release in the same way that Bt cotton must be approved by a GEAC board (although that board has not released a new list of approved varieties since 2012). However, ICAR tracks the most widely bred public and public/private partnership produced in Andhra Pradesh/Telangana. Since 1965, public breeders have released only 219 commercially popular varieties (197) and hybrids (22) in Andhra Pradesh/Telangana, fewer seeds than Bt cotton companies produced in either 2009, 2010, or 2011 alone. According to ICAR documents, the private sector released nine popular hybrids over this same period for a total of 228 popular seeds. Farmers that I met planted 49 varieties of rice, 14 of which account for 93% of all seed choices. It takes twice as many cotton seed brands (31) to reach the same seed choice coverage. As the thick/thin divide shows, these seeds are not just released more slowly and in fewer

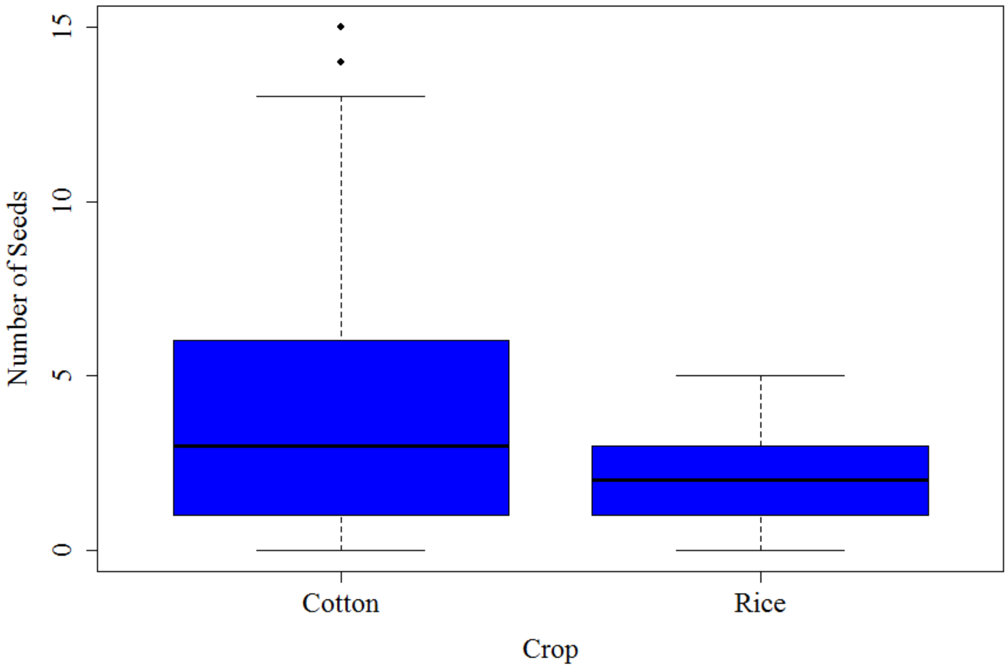
[15] This is a common way for school students to address teachers when asking questions

numbers, they can be more easily distinguished from one another. I asked Srirama Rao why the same few seeds maintained market dominance in Telangana year after year:

> They are highly preferred by the consumers and also by the millers and traders…mainly because: they have good milling quality, good cooking quality, and good keeping quality. [Warangal 14, BPT 5204, MTU 1010] are medium slender grains. Of course MTU 1010 is a little long, but it is preferred by the millers because it goes as parboiled rice to other states. And they are high yielders, and become ready immediately when the price in the market. Whereas other varieties which are bold (thick), and are not preferred by the consumers even though they are high yielders. They yield more than, like, BPT 5204, maybe five bags more…they have a very good milling quality, very good cooking quality, and very good keeping quality.

I will argue below that farmers conduct better trials with rice than they do with cotton, but suffice to say here that rice farmers typically conduct their experiments by balancing social and environmental learning over multiple years where cotton farmers tend to plant multiple seeds in their fields to evaluate differences, and then ignore those findings. Farmers have a limited set of possible rice choices when compared to cotton and because farmers typically plant fewer different seeds at a time in their fields to trial them (**Figure 6.2**).

Figure 6.2: Comparison of Farmers' Rice and Cotton Choices per Farmer per season, Averaged for each farmer's choices 2012-2014



Descriptive Statistics

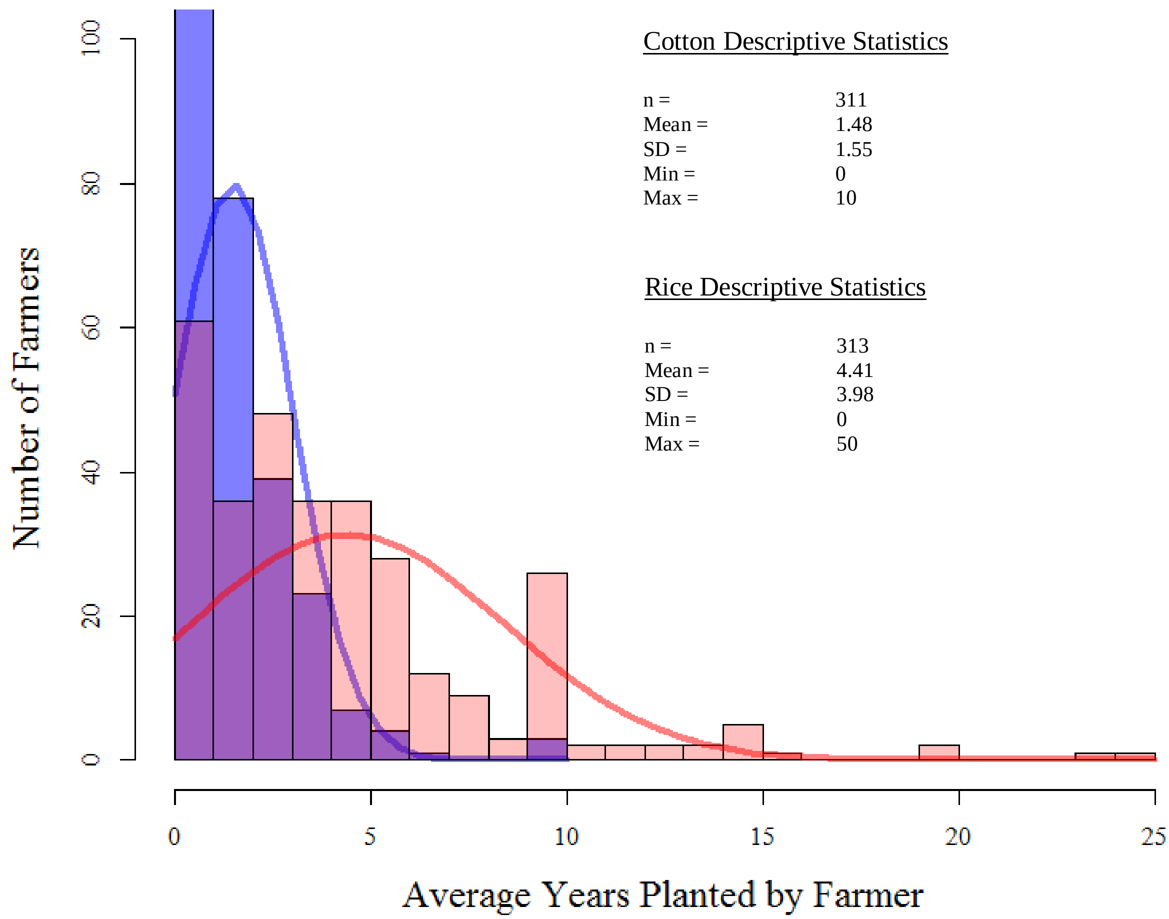
	Cotton Choices	Rice Choices
n	324	331
Mean	4.65	2.13
SD	3.22	1.09
Minimum	1	1
Maximum	15	5

Source: Flachs Farmer Survey 2012-2014.

This difference is significant at $p < .001$, with a standard deviation that puts much of the variation in cotton agriculture between one and eight cotton seeds per farmer but only one and three rice seeds per farmer. The experience of choosing rice and cotton seeds in a shop is different as well. A farmer buying cotton seeds may encounter hundreds of glossy packages in a shop, with no clear way to differentiate between them. The same farmer is likely to encounter only a few different varieties of OPV rice seed in a shop, sold in burlap sacks without trade names or impressive packaging. The same farmers who planted an average of 4.65 different cotton brands 2012-2014 only planted 2.13 different types of rice varieties or hybrids over the same period. Rice choice for these farmers was far more stable. As rice is typically planted in both *kharif* and *rabi* seasons, planting two seeds geared toward these two different seasons makes sense. That is, even if the same seeds are being planted again and again, one would expect farmers to consistently plant about two seeds to take advantage of their fit to each season. In cotton, cropped only once, the larger spread of seed choices indicates that each farmer, in general, had a more difficult time choosing which seeds to plant.

Because they are working with fewer seeds in separate fields and the seed choices are much more consistent over the 2012-2014 period, farmers can also spend more time learning more about particular seeds. Taken as an average for each farmer 2012-2014, rice choices were planted significantly longer ($p < .001$) than cotton choices and with a range of variation that allows most farmers between zero and eight years of experience with rice seeds but only zero to three years with cotton seeds. Zero years in this calculation and figure refers to seeds that were never before planted. Compared with cotton, farmer planting rice seed choices benefit from more time (**Figure 6.3**), more stability, and less choice overload.

Figure 6.3: Histograms comparing average number of years rice and cotton seeds are planted per farmer



This histogram shows frequency (Y axis) with which the farmers had planted seeds in the year asked 2012-2014 (X axis) for Bt cotton (blue) and rice (red) seed choices. Source: Flachs Farmer Survey 2012-2014.

Given these differences in planting experience, it is unsurprising that rice seeds are less likely to be novice plantings. One-hundred and twenty-three out of 585 (21%) rice choices were first time plantings 2012-2014. This is compared to 715 out of 1443 (49%) cotton choices. These differences manifest in a farmer population that knows which rices are thick and therefore more disease resistant, high yielding, and fetch a lower price in the market; as well as those which are thin and therefore more susceptible to disease, lower yielding, but can be sold at a higher price (**Table 6.1**). They remember rice choices with greater certainty each year than cotton, and the differences are easily observed across fields and in the marketplace.

So far in this chapter I have been calculating numbers based on seed choices reported in the year that I asked about them as this probably gives the most accurate data. However, my surveys also asked farmers to recall seeds planted in the previous year, which introduces a problem: rice recall is more difficult to track than cotton recall. Because farmers most often plant two seasons of rice during the *kharif* the same methods for tracking cotton seed recall do not work – farmers asked in the *kharif* season in 2013 what seeds they plant cannot be resurveyed on their *rabi* seed in 2014. Cotton, by contrast is planted at the beginning of the *kharif* season and harvested during successive fruitings November through early March. Data on seed choice for the year asked thus has a bias against seeds planted during the *rabi* season as farmers had not yet planted those seeds[16].

In 2013, I resurveyed 97 farmers on 217 rice seed choices from a 2012 pilot study in four villages. In 2014 I resurveyed an additional 219 farmers on 481 seed choices. Farmers correctly recalled 124 out of 217 (57%) seed choices in 2013 and 256 out of 482 (53%) choices in 2014.

[16] To triangulate an accurate perspective on farmer rice recall, I compared 2014 and 2013 rice seeds recalled to farmer choices given the previous year, looking only to see if that seed was recalled, not counting false recalls in instances where farmers recalled more than one seed that may have been planted in the winter season. For example, if a farmer stated that she was planting Warangal 14 rice in 2012 and in 2013 recalled that she had planted Warangal 14 and MTU 1010, I counted this as an instance of correct recall and ignored the MTU 1010 choice and assumed that it was a winter rice choice. If a farmer stated that she planted Warangal 14 rice in 2012 and in 2013 recalled planting only MTU 1010 I counted this as a failed recall. In cases where some seed choices were recalled and others were not, as when a farmer stated that she planted one seed and then recalled several more the following year, I relied on common seed choices I observed to treat these on a case by case basis. For example, MTU 1010 and hybrid breeding rice locally called “male/female” rice are almost always winter rice choices and thus overrepresented in the recall lists and underrepresented in a given year’s choice list. In this way I aimed to best capture how many recorded rice seed choices were then recalled the following year and not to penalize farmers for missing rice choices that had not been planted when we surveyed farmers the previous *kharif* season. As with cotton, when a seed was reported in one year and recalled in the next year, both choices were counted as a recall; when a seed was reported in one year and not recalled in the next but a different seed was recalled, both choices were counted as a non-recall.

These rates are not wildly different from cotton's 57% and 41% correct recall rates in these respective years, but there are some important differences. As the most popular seed in the sample it is unsurprising that Warangal 14 was in both years the most well remembered seed. Many farmers lost points on their recall because they named particular facets of the seed (recalling the seed as thick or thin, say) or often by mistaking a variety of Warangal seed for Warangal 14. Many confused Warangal 32100, for example with BPT or with Warangal 14, which makes phenotypic sense as Warangal 32100 has less name recognition and credits both of these varieties as parent lines. Farmers tended to misremember the rarer hybrid rice seeds with their confusing company and brand names. The growing hybrid seed market will be discussed further below, but the overwhelming majority, 577 out of 704 rice seed choices (82%) are OPVs, with hybrids accounting for only nine percent of the sample. The remaining seeds were either identified as 'do not know' or were most likely OPVs that farmers misnamed.

Another kind of triangulation in the differences between farmer knowledge of rice and cotton seeds is their agreement on seeds' phenotypic qualities. Using ethnography to inform survey questions, I identified important qualities that arose during ethnographic observation and focus groups for cotton and rice. During the 2014 household seed survey, I asked farmers about a few characteristics for each seed that they planted that year. The degree to which farmers agreed with each other thus indicated how much certainty existed for various seeds among farmers. While agreement alone does not necessarily mean that the farmers were 'correct' about a seed's particular quality, it does indicate that farmers have a widespread understanding that something is true.

For each cotton seed choice, I asked farmers to predict boll size (small, medium, or large), growth habit (bushy, tall, or both) and I asked farmers if seed in question was a Bt seed.

For rice seeds, I asked farmers to identify if the seed was thick or thin, how many bags of rice could be expected from the seed, and how many days it would take to harvest the crop. All of these factors are important agronomic indicators espoused by farmers and reflect important decisions and knowledge about seeds. They should also be clearly evident when the crops grow and at the forefront of farmers' minds when making seed choices as these factors ultimately reflect the yield and management of these crops. Especially among cotton planters, farmers might respond that they had no way of knowing what the agronomic factors were because they had not planted the seeds. I marked this as 'do not know' but it clearly reflects a serious problem. The disrupted social pathways that provide knowledge of seed properties were either so inconsistent or untrustworthy that farmers were not willing to justify these choices to an anthropologist with a survey.

Boll size and growth habit, defined by the farmer's taxonomy of tall, bushy, or both, are easy to observe and crucial factors for cotton agriculture, as these reflect yield, fertilizer response, and susceptibility to pest damage. While dependent on a large number of factors including inputs, weather, and soil conditions, these phenotypic factors are at the front of farmers' minds when making seed choices and learning about seeds through experiments or social emulation. Yet the spread of this data (**Table 6.1**) shows a consistent divergence of farmer opinions.

Table 6.1: 2014 Cotton Knowledge Consensus as a Row Percentage

	Boll Size				**Growth Habit**				
Seed Name	**Small**	**Medium**	**Large**	**DNK**	**Tall**	**Both**	**Bushy**	**DNK**	**N**
Yuva	4	18	51	27	31	31	14	24	**104**
ATM	5	34	43	18	36	23	12	30	**61**
Jadoo	6	36	51	6	26	28	19	28	**47**
Jackpot	4	29	64	4	25	18	14	43	**28**
Dr. Brent	16	24	48	12	40	28	12	20	**25**

Sarpanch	4	17	33	46		29	33	8	29	**24**
Bhakti	0	32	45	23		36	23	18	23	**22**
Mallika	6	47	47	0		24	12	35	29	**17**
Neeraja	21	50	21	7		36	29	21	14	**14**
Ankur 3028	0	17	75	8		50	17	17	17	**12**
Padmaja	0	50	25	25		12	62	0	25	**8**
Rasi	12	50	25	12		25	38	12	25	**8**
Denim	0	50	33	17		33	17	17	33	**6**
Bindas	0	0	60	40		40	20	0	40	**5**
Tadaka	0	40	60	0		40	0	40	20	**5**
Arjun	0	75	0	25		25	25	0	50	**4**
Brahma	0	0	100	0		50	0	25	25	**4**
Ujwal	0	0	0	100		100	0	0	0	**4**
Ambuja	0	33	33	33		67	0	0	33	**3**

Source: Flachs Farmer Survey 2014.

For this table, only seed choices with at least three planting farmers are shown. While complicated, this table reveals that more than half of farmers planting a given seed rarely agreed on boll size or growth habit. Indeed, ‘do not know’ often commands as many choices as the others. Few farmers answered that boll size for a given seed would be small, indicating that it would be difficult to pick but that the cotton plants would produce a greater quantity of bolls more resistant to insect attacks. This probably reflects a cautious optimism that their plants would produce large and heavy cotton that would fetch a higher price and be easier to pick, although it would also be more susceptible to insect predation and produce fewer total bolls. A generally understood farmer consensus (above 52%) appears only twice before seed choices fall to a handful of farmers: that Jackpot and Ankur-3028 produce large bolls.

Compare this spread to the spread of knowledge represented in rice (**Table 6.2**).

Table 6.2: 2014 Rice Knowledge Consensus as Row Percentage

	Thickness			Yield[17]					Duration				
Seed Name	**Thick**	**Thin**	**DNK**	**10-20**	**20-30**	**30-40**	**40-50**	**50+**	**Short**	**Med**	**Long**	**Extra Long**	**N**
Warangal 14	1	97	1	0	9	57	32	2	9	61	23	8	**67**
MTU 1001	100	0	0	2	10	39	46	2	10	41	39	10	**41**
BPT 5204	0	100	0	0	0	48	52	0	0	33	62	5	**21**
JGL	9	91	0	0	8	42	42	8	0	67	33	0	**12**
3100	0	100	0	9	9	36	45	0	0	82	9	9	**11**
Ganga Kaveri	0	100	0	0	25	62	0	12	0	62	38	0	**9**
JGL-384	12	88	0	12	12	12	52	0	12	50	25	12	**8**
MTU 1010	100	0	0	0	0	67	33	0	0	67	33	0	**6**

Source: Flachs Farmer Survey 2014.

Again focusing only on seeds chosen by three or more farmers, the spread of rice seeds is predictably smaller and the consensus predictably more confined. Thick- and thin-ness of rice is almost universally known and there is a high degree of convergence around germination time and overall yield. Only five rice planters in the six village sample claimed in 2014 that they did not know enough to offer an opinion on their rice seed choice. Of these, two planted new hybrids and two did not know the name of the seed they had planted. Almost no farmers ever mistake thick seeds for thin seeds, and more than 60 percent agree on their rice duration, the number of days it takes from seed to harvest in seven out of the nine seeds listed. Yield sees a greater spread, although most of this is concentrated between 30 and 45 bags per acre. Even so, the spread of estimates remains closer than that found in cotton.

This section has argued that farmers have a deeper and more nuanced knowledge of rice seeds than they do with cotton seeds because of the fewer options in rice seeds, their greater

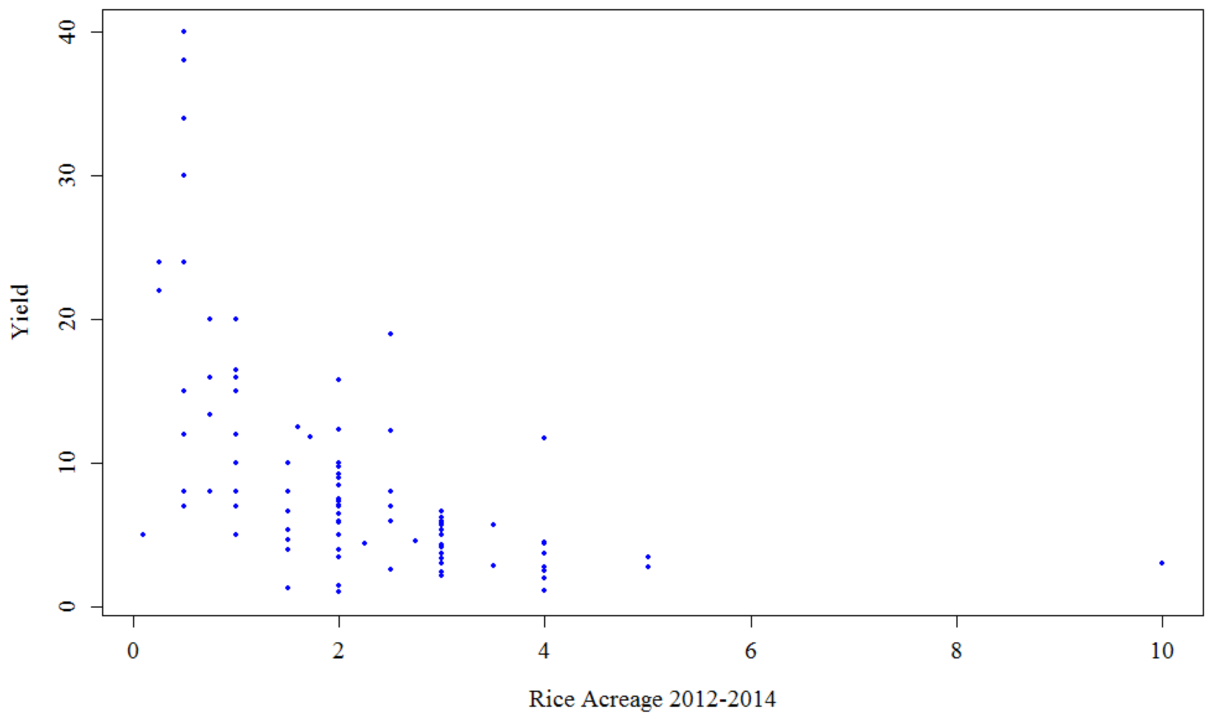
[17] I collected both yield and duration as discrete values in bags and days respectively, and summarized them for the sake of clarity here. Similarly to growth habit in cotton, rice yield is not an inherent property of rice but one heavily tied to inputs and growth. However, like growth habit in cotton, farmers type yield as a somewhat predictable phenotypic variable. This is because, in general, farmers agree that thick seeds yield more and thin seeds yield less.

experience with those fewer seeds, and, importantly, the more detailed uses that they require of those seeds. The important factors of rice cultivation are thus highly consistent in the minds of individual farmers and dependent on their personal needs, in a way that cotton seeds are not. The next section will discuss variability among the farmers and the influences that this social landscape and environmental learning has on rice seed decision making.

The Underwhelming Influence of *Pedda* Farmers and Vendors in Seed Choice

In cotton, the social conforming that leads to widespread seed fads is additionally filtered through the social hierarchy of the village. As shown in the previous chapter, this conformist bias is not because socially important *pedda* farmers have better yields, but more because they are expected to know best. Within the widespread uncertainty that characterizes the anarchic cotton seed market, travelling brokers and shop owners have an additional extra sway over what farmers plant. However, this influence is far less important to the rice seed market. The *pedda* farmer, so important to the social dynamics of cotton farming (if not the actual yield responses) has negligible impact on rice agriculture because the seeds are more consistent, the information more reliable, and the seed vendors less important in the moment when farmers select their seed. In cotton agriculture, the firm suggestion of a shop owner can sway acres of planting to a particular seed. In rice, farmers tend to plant what they know. In fact, the modest relationship suggested by rice acreage and yield is a *negative* relationship: farmers devoting fewer acres to rice tend to invest more in those acres to maximize production (**Figure 6.4**).

Figure 6.4: Scatterplot of 2012-2014 Warangal 14 Yields Against Rice Acreage



Linear Regression of Acreage 2012-2014 vs. Yield: r^2 = .076, n = 146
Source: Flachs Farmer Survey 2012-2014.

Much of the data is clustered among farmers who plant between .25 and 3 acres of rice and the coefficient of determination reveals that there is no linear relationship between rice acreage and yield. However, there is an important analogy to the trends of farmers in cotton. While the largest cotton planters tended to see slight advantages in yield or slight social advantages at the far end of acreage in cotton, the most successful rice farmers tended to plant fewer acres. When asked in focus groups, farmers do not name *pedda* farmers as a group with unfair advantages in cultivation as they suggest in cotton cultivation. This emerges from the seed survey data as well. In 2012-2014, for instance, the largest 20% of farmers planted 27% of the cotton seeds visible in the village, more than their share. In rice, where each quintile plants roughly equal numbers of seeds, the same group of farmers planted 21% of the seeds visible to the village. Yield is not necessarily the most meaningful goal that farmers chase in rice cultivation, and so yield response is not necessarily the best test of if and how farmers learn from their rice paddies. Farmers tend to plant thick rices when seeking to minimize pest damage and maximize yield, and plant thin rices to maximize price and taste. That small farmers tend to do somewhat better suggests that, in rice, it is sufficient to do "well enough" with rice. For the larger farmers, maximizing production is an unnecessary use of resources. That the relevant knowledge of thick/thin or taste is widely known and agreed-upon means that rice knowledge is more in the domain of the individual and less in the domain of experts external to the farm or mediated through the village social hierarchy.

Farmers from Kavrupad, Ralledapalle, and Srigonda, the three villages where my ethnographic and quantitative data is strongest, tend to buy from specific, trustworthy, local vendors. 52% of the seeds farmers in these villages planted were either saved or from village shops, while the rest were purchased from shops in regional cities like Warangal or Nekkonda, or from black market brokers. Unlike cotton seeds, these vendors are not asked to determine popular rice choices. Rather, farmers tend to either ask for specific seed brands or at minimum a thick or thin seed. This tendency is reflected in the sample as a whole. That experts are trusted sources of seed but not necessarily information is reflected in the buying loyalty of farmers in my six sample villages (**Table 6.3**). Bikshapathi Rao is a small input shop owner in Parvatagiri, the *mandal*[18] seat. His is one of three agricultural input shops in the town, and during 2012-2014 he provided 57 out of 326 (17%) rice seed choices to farmers in the Ralledapalle and Kavrupad areas, the single largest vendor. Srigonda's farmers additionally purchased 36 out of 130 (28%) rice seeds from the Mahalakshmi Cooperative, a trusted shop that serves Srigonda farmers. Like

[18] Mandals are municipal conglomerations of villages below the level of districts, analogous to the way that counties are subdivisions of states.

cotton farmers, rice farmers do not remember where they purchased a large (239/655, 36%) percentage of their seeds. Also like cotton, the number of farmers who did not know where they bought their seeds is also spread evenly among farmers of different sizes. Unlike cotton, however, this lack of recall is less detrimental because farmers do not rely so heavily on shop owners to determine which rice seeds are best, they rely on these shop owners to provide viable seed.

Table 6.3: Seed Vendors accounting for more than 1% of Total Rice Choices in All Villages 2012-2014

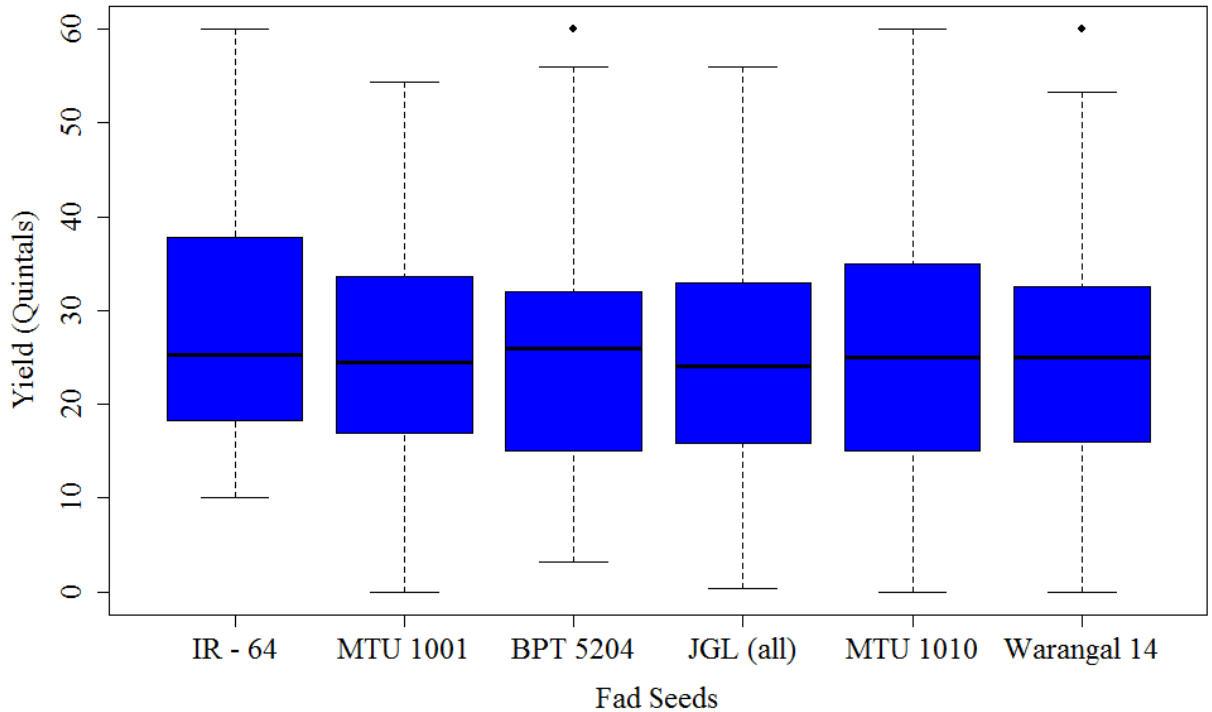
Vendor name	Seed choices from Vendor	% of total choices
Saved Seeds	59	14.18%
Bikshapathi	57	13.70%
Hybrid Broker	40	9.62%
Mahalakhsmi Cooperative	37	8.89%
Vasenta Rao	18	4.33%
Vijay Lakshmi Fertilizers	16	3.85%
AP Seeds	10	2.40%
From Relative	10	2.40%
Swathi Fertilizers	10	2.40%
Kankadurga	10	2.40%
Anil Rao	9	2.16%
Deva Sai	8	1.92%
From Pedda Farmer	8	1.92%
Prem Chinder Rao	8	1.92%
Sri Rama	7	1.68%
From Neighbor	7	1.68%
Laskhmi Reddy	7	1.68%
Rama Rao	7	1.68%
Maruthi Fertilizers	5	1.20%

Source: Flachs Farmer Survey 2012-2014.

Hybrid brokers in this context refer not necessarily to black market seed vendors but to company agents who sell hybrid seeds. As rice seeds are almost always publically developed varieties, the government does not place distribution restrictions that fuel a rice seed black market as is seen in cotton. Bikshapathi Rao, hybrid brokers, the Srigonda cooperative, and Vasenta Rao are all local community institutions in the sense that all are located in or near the town where farmer consumers live and all have a direct stake in the community. This distinguishes them from the busy and often pushy shop owners of Warangal, although this proximity can lead farmers to view them as too provincial when they buy cotton seeds or pesticides. Shops in nearby cities like Warangal or Nekkonda are seen as better sources of high quality agricultural commodities such as those. Interestingly, the most oft-used 'vendor' is the farmers themselves. Rice can be and is often saved, giving farmers experience not just with the named OPV but with the specific germplasm of their fields. Rice saving is, of course, its own set of complicated knowledge and will be described in greater detail below. Suffice it to say that farmers who save their seeds necessarily know where they came from and have a reasonable expectation of how they will perform.

As with cotton, rice yields did not differ significantly between farmers. Even between the IR-64 and JGL varieties, the two seeds with the largest differences in mean yields, IR-64 did not provide statistically greater yields than JGL in an independent two-group t-test ($t = 1.58$, p value = 0.12) (**Figure 6.5**). Consistent with farmer narratives, BPT 5204's range of yield variation was comparatively lower and its popularity as a seed choice speaks to its taste and high selling price. That said, no yields of the popular different rice were statistically different. Like the cotton seed yields, the rice yield averages were all well within the range of variation for the sample as a whole.

Figure 6.5: Boxplots of Rice Yields for the Most Popular Varieties 2012-2014



Descriptive Statistics

	IR-64	MTU 1001	BPT 5204	JGL(all)	MTU 1010	Warangal 14
n	36	132	101	132	198	216
Mean	30.44	26.51	25.93	25.12	26.57	26.01
SD	19.05	15.91	14.96	12.96	17.08	15.21
Minimum	10.00	1.00	3.18	.40	.00	.00
Maximum	90	100	100	70	160	120

Source: Flachs Farmer Survey 2012-2014.

This section has argued that farmers as a whole respond to first-hand environmental knowledge in their rice seed decisions. With fewer choices planted for a longer period of time and with a greater knowledge base both on the level of individual farmers and in the widely shared consensus about agronomic qualities of rice seeds, farmers are in a better position to develop and use environmental learning. This is partly to do with particular inherent qualities of rice and partly to do with the way in which rice knowledge is socially mediated. In this market, farmers are less reliant on vague black market brokers, callous vendors, or large neighbors for seed choice knowledge – for the most part, farmers agree on the widely understood buzz (**Table 6.2**) and their seed choices consistently favor the same seeds (**Figure 6.1)**. Given that no seeds perform better than others, a focus on yield above all else is a poor measure of farmer knowledge and management in rice seeds. If a rice yield is substandard, damaged, contaminated with *beriki*, or if the market price is below what a farmer wants to pay, the farmer can always at least eat that product. Other factors inherent to rice such as its taste, its ability to be saved, and the way that farmers must handle the rice throughout its life cycle from nursery to harvest and seed saving make rice inherently easier to learn about. The next section discusses that knowledge in action during the decisions and management of saved rice seed.

Rice Saving and Optimizing Knowledge, Reliability, and Performance

The decision to save or buy seeds begins with a few easily articulated economic and agricultural factors: is there enough money to buy new seeds, do we need cash more than saved rice, is the price good, is this rice suitable for a second planting, or did the crops exhibit any characteristics like disease susceptibility that would make them undesirable in the next season. Then there are more social reasons to save or replant: wanting to seize on a new opportunity like a hybrid rice rumored to deliver a good yield, emulating a neighbor who performed well with other seeds, wanting to appear savvy or modern for working with sales representatives, or not wanting to go through the effort of selecting or saving new seeds. But because farmers do more with rice, physically handling and inspecting it at various stages in production, and because cash-cropped rice is rare, the urge to follow the untested choice of a neighbor is diminished in rice cultivation.

"*Wari same adi*" laughed a farmer in a Ralledapalle focus group. "All the rice is the same. The yields, however they will be, will be almost the same in all of the different rice seeds." "Every year," I asked incredulously. "Every year." "But in cotton?" The farmers rolled their eyes at this question. "In cotton there are many differences. It is for that reason that we are changing [seeds]!" In the wealthier and higher caste village of Srigonda, farmers in a focus group agreed: "Those rice seeds that taste good will not be changed [as with cotton seeds]. The taste must be good. The taste in the rice should be good." As in many languages spoken by people who subsist primarily on rice, the same word connotes both 'cooked rice' and 'food' in Telugu. Rice, and rice that is saved or eaten especially, is not simply a purchased commodity like cotton. Maximizing yield is secondary to producing enough, or making do one's primary food crop. In many instances rice does not need to be outstanding to be selected again by a farmer, just good enough to satisfy the common or individual preference. One can eat what is needed and sell the rest.

One key informant (and friend), Bikshapathi, is a graduate of the NGO-run school in Kavrupad where I volunteer and offered to show me around the area's fields. Like many Telangana farmers, his family, the children and grandchildren of the patriarch who founded their tribal *thanda*, plants a few separate *guntas*[19] of special, thin, BPT 5204 rice where (thanks in part to his training as an organic chemist) the family sprays fewer pesticides and devotes fewer resources. This food is not destined for sale at the market, but is just a convenient way to have a steady supply of rice that the family likes. As for the rest of his family's rice land, intended for the market, the family will sometimes save and sometimes buy new seeds. "It depends how much we get," he explained. "If we yield thirty-five or forty bags from a rice seed, well save that

[19] An area of a rice paddy of variable size, about 1/40th of an acre, set downhill such that water flows from one area to another. In India, paddy refers to rice crop rather than to the land itself, and I have adopted this parlance to avoid confusion.

seed again." "And below that point," I asked? "That's when we know we need to buy new seeds again. It's like a target." Rice buying or saving decisions are flexible and contingent upon environmental feedback, including field performance. Rumors of new productive seeds therefore hold less sway over farmers' imaginations, at least not in years when their seeds are producing enough.

Common wisdom holds that seeds can be saved and replanted for up to two years following their purchase. That is, seeds should be bought new at least every three years. After several years of replanting, farmers believe that yields decrease and it becomes increasingly likely that seeds from other varieties will fall into the field resulting in *beriki* seeds. By the third year, rice plants and their seed grains will have too much variability and thus fetch a poor price in the market. This is in part because the rice varieties that farmers use are OPVs, explained ANGRAU scientist Dr. Ranitha. The risk of inbreeding and yield depression lead people to "believe that the new seeds are always better although they should last around three years before needing to be rebought." Frustrated on one hand with what she sees as an increasing focus on commodity farming, Ranitha nonetheless appreciates the logic in buying new seeds to gain a better profit margin. "In the past, people used to save seeds and had some greater knowledge and patience for the practice. Now, they want to buy new seeds and don't want to take the risk of saving and ruining the next year's crop." For their part, farmers shrugged at the implication that they should be saving seeds more often. "Well, you wouldn't wear the same shirt every day," mused one farmer.

In addition to overall production, farmers evaluating seeds for saving additionally look for qualities of *beriki*, *talu*, and *kalthi*. As explained above, farmers diligently inspect their harvest for these defective seeds, as they cause problems for the saving and replanting process.

However, these same qualities important for farmer decision-making in the field are also important when farmers go to the market to sell their harvest. Both farmers and traders use their eyes, hands, and tongues to test rice seeds for their durability, taste, color, and starch content. These qualities are equally prized by farmers looking for high-performing seeds and grain buyers looking for any excuse to mark down the price of seeds. That is, farmers are economically rewarded and environmentally rewarded for maintaining the same qualities in their rice fields.

The market can be a stressful place for farmers, who stand with their piles of newly weighed grain as merchants make their rounds. Seed buyers travel in groups and compare notes, sighing with disapproval at each pile of grain and offering prices below the mandatory government rate. Farmers will often accept these discounted prices because the merchants, unlike the government, will pay in cash that same day. Flashing gold rings and chains, they reach a hand into the piles of grain to feel for moisture that can lead to mold and rot. After examining a fistful of rice for cracks or discoloration, one or several merchants knead those grains with their palms to see how tough the seeds are, and how many are filled with a solid, white, healthy-looking starch. The more variation between grain sizes, consistency, color, moisture, and general *feel* that the merchants perceive, the more they shake their heads and argue the price down.


Buyers inspect rice seed for color, consistency, and starch content at a Warangal district market. The farmer, clad in a red turban, has been pushed to the back of the crowd while brokers and onlookers render their judgement.

Because they do so in groups, some farmers can play buyers off one another. Yet this is rare. More often, buyers make no effort to contradict the judgments passed by other buyers and farmers sullenly accept the prices offered to them. No one, after all, wants to go home empty-handed. Therefore, keeping one's rice clean, dry, and uniformly healthy is paramount.

When rice is saved for a farmers' personal use, the stock must be sifted to remove these same undesirable qualities – replant one errant *beriki* seed and it will yield one hundred grains that will bring down your price in the market. Farmers take care to rid themselves of these seeds at harvest and then again when they soak and sprout seeds as preparation to planting them in rice nurseries. When watching the plants grow, farmers take note to see if the plants are becoming increasingly susceptible to disease, another sign that the pest cycles are adapting to their cropping patterns or that the seed is losing its yield potential. When the time comes to harvest seeds, the entire family along with hired labor looks through their plants. Telangana farmers employ a mix of rented harvesting machines and manual labor, but in both cases they check the fields for errant or diseased plants that would preclude replanting. "You can keep saving and replanting until the backbone (the plant's seed bearing ear) becomes weak and sags", advised one farmer. Employing a more sobering metaphor, one farmer warned "You can save for a second year only. If a woman gives birth to four children, one will be sick, and so too impurities creep in to the saved rice." If families are considering saving the seed, someone, usually but not exclusively the male head of the household, inspects the rice – one farmer even counted the grains on several rice stalks as a proxy for the health of his fields.

After the rice has been collected, winnowed, and bagged, farmers can calculate how much they can save beyond the minimum they need to sell to recoup their losses and gain a profit. Alternately, like Bikshapathi, they set targets for their family's needs and sell anything produced beyond that minimum. Farmers' knowledge, and often their personal touch, is required throughout each step. This is because seed saving decisions are often based on a conglomeration of subjective agronomic and economic properties. "There's no difference between saved, sold, and eaten rice," explained Ralledapalle *thanda* farmer Ravinder when I asked if farmers chose particular seeds for particular fates when working in the field. "It's all harvested together and bagged together. The only difference is the presence of *beriki* which is not really good for eating or replanting". "Look to see that the rice plants look healthy and that there's no disease in the field," advised another farmer. "New seeds can be saved twice, but after that the harvest itself will not come. If you have no money you can save a second time but even if you're out of money you have to buy new seeds that third time around. Always save one bag [for replanting seed], just in case." There is no simple economic cost benefit calculation to saving seeds as both rich and poor farmers have incentives to replant rice. Poor farmers claim that they don't have the money to buy new seeds while wealthier farmers say that they have less to worry about from a bad yield or have fewer pressing seasonal debts. In all cases farmers must make decisions about their seeds based on their particular situation at that time, usually not seeking to maximize yield but to maximize reliability.

This section has shown that the process of rice saving depends heavily on farmers' firsthand knowledge and implementation. The same factors that influence seed saving decisions are also the qualities scrutinized by seed buyers, and so farmers have an economic reward for keeping abreast of variation in their seeds. However, yield is only important to a point: farmers and plant scientists believe that depressed yields that come from continually saved seeds and so farmers tend to set yield targets, changing only when their harvest falls below that mark. Seed saving is a strategy not for optimizing yield but for optimizing 'doing well enough'. Furthermore, the process of saving rice requires farmers to constantly use a flexible set of knowledge directly connected to economic rewards and the environmental feedback of pests, inputs, and plant growth. As an agricultural practice, seed saving is therefore intimately tied to an adaptive skillset based in local knowledge. At the very least, the widespread habit of buying new seeds after saving for two years gives farmers a chance to reflect on new possibilities and weigh them against seeds they know. Some farmers opt for new or hybrid seeds in this year while others will again choose OPV rices. Lacking such opportunities to develop knowledge or an incentive to use them, cotton seed choices are more connected to capricious rumor mills and marketing campaigns. However, some rice varieties are not designed to be saved. The final section discusses hybrid rice varieties and the ways in which hybrid rice seed decisions mimic hybrid GM cotton seed decisions.

Social Politics of Rice Knowledge Between Hybrid Breeder Rice and Other Rices

So far I have focused on OPV rice knowledge, the knowledge of at least 82% of the seed choices in the sample. However, since I began working in Telangana a minor but growing market for hybrid seeds and for hybrid breeding seeds has become attractive to some farmers.

Hybrid seeds provide an interesting analytical bridge between cotton and rice decision-making behavior, because hybrid rice seeds resemble hybrid GM cotton seeds in a number of respects. Rice knowledge, following suit, begins to resemble cotton knowledge with these seeds. Hybrid rice seeds behave much more like cotton seeds than OPV rice seeds in the sense that they are more commodified and are more often sold by farmers like a cash crop rather than eaten. They are marketed by brand name and bought by farmers who have scant knowledge of their specific properties; they are bought with one season rather than multiple seasons in mind; they are purchased as a new product of private industry rather than chosen time and again because of their acknowledged reliability from a public breeder. Thus does the calculus for rice become simplified – fewer considerations of taste, use, or reliability, and more considerations of yield. As with cotton, hybrid rice knowledge becomes less tactile and less reliable .

Like hybrid GM cotton, hybrid rice is also mostly controlled by the private sector. When I asked ICAR scientist LV Srirama Rao what effects privatization had on farmer seed options, he couched his response in the frustrations that many hardworking officials have with corruption and inefficiency in the Indian bureaucracy.

> L: Hybrids are all with the private sector. Though we have a good number of hybrids in the public sector, the public sector could not make a dent…In the public sector (of which Srirama Rao is a member) they could not make seed production very successful. You know the Indian system, I think by now you are aware of it. If it is a government job, no one can take you to task…Here, the government job is the most secure job, even if you are found to be corrupt or something like that. Some action will be taken but you will not lose the job. The security point attracts the people who go for government jobs. In this way, some of [the government scientists] could not master the skill of seed production for hybrids. Only those farmers in the Warangal, and then Karimnagar area[20] have mastered the skill of seed production…We get big MNCs.
>
> A: In cotton the hybrids are in the hands of the companies, and mostly with rice the hybrids are in the hands of the companies.

[20] Two districts in Telangana

L: 90 percent. I'd say even 95 percent. Hybrids in rice are with private industry, Bayer, Syngenta, Advanta, Pioneer, that is DuPont. And local companies like Ganga Kaveri, Mahyco, Indo American, Kaveri, or JK. They're all popular. They're very, very key players in hybrid rice.

A: But still hybrid rice is not so popular [among farmers].

L: It is around 2.5 million hectares of area. It is 43 to 44 million hectares of area in India, rice area. And then if you come to Andhra Pradesh its hardly 40 lakh hectares. So there is no hybrid rice cultivation in Andhra Pradesh, only seed production.

Private, often foreign companies drive hybrid seed sales even as most farmers prefer local varieties developed by public state breeders. Whether this is because the breeding programs are ill suited to the demands of hybrid production as Srirama Rao suggests or because farmers are less tempted by the promises of hybrid breeders is unclear. But while farmers tend to eschew growing and eating hybrid seeds as a whole, there are two important and growing exceptions. The first is Indian hybrid seed company Ganga Kaveri.

Since 2012 Ganga Kaveri stationed a representative in Parvatagiri, a municipality central to Srigonda, Ralledapalle, and Kavrupad (**Figure 2.1**). This agent sells hybrid seeds but also rents out a labor-saving rice harvester. By working closely with farmers and renting out his harvester, the Ganga Kaveri dealer built up a trust relationship that encouraged farmers, especially the homogenous communities of Lambadi tribal farmers near Ralledapalle, to switch to his seed. "Until last year almost everyone was cutting [rice plants] with their hands," explained a Ralledapalle farmer in a focus group. "From this year we will all be using that machine." The machine is cheaper and much more time effective than family labor, especially as their increasingly educated children move to the cities. Farmers in the area were initially hesitant to plant hybrid seeds, concerned that they would falter under local conditions. "There are only a few types of hybrids and those hybrid seeds can't withstand these kinds of natural conditions (*prakruti*). Normally we use these local seeds, and all the seeds [respond] the same way. They are not different." To woo farmers accustomed to chasing cotton yields but who value rice seed reliability, Ganga Kaveri established a social relationship through a cost saving and impressive machine. Following this initial connection, a Ralledapalle farmer centrally located to the surrounding tribal *thanda*s was recruited to draw a modest salary as a hybrid rice agent. His locality and personal touch additionally make Ganga Kaveri a popular choice. That the seed itself is inexpensive, rumored to be more pest resistant, and tastes and looks like Warangal 14 is additionally appreciated.

More tenuous has been farmers' commitment to what they call male/female rice, the hybrid breeding stock bought and sold by MNCs like Syngenta or Bayer. "From next year I won't plant that rice," said Yakub, a focus group discussant. "Last year Yakub didn't get a good yield from the male/female rice," offered the farmer sitting next to him. Yakub scowled. Hybrid companies ask farmers to plant male/female rice under a very strict regimen of soil tests, watering, and chemical applications, so that they can produce viable hybrid rice then sold throughout South Asia. Farmers are not necessarily privy to this supply chain because their interactions tend to be quick and to the point with company representatives. "I heard they are used as a high end biryani rice," suggested one farmer. Even Bikshapathi the organic chemist was at a loss, suggesting that the seeds were ground into powder and used to provide filler material for pharmaceutical capsules.

Hybrid seed producing companies use brokers and advertisements to recruit growers in the winter season, and then briefly check to ensure that farmers are willing and able to invest and water their lands to the extent that the rice requires. Usually this involves a soil test as well. Hybrid companies then provide the seeds, tell farmers how to space and align their crops, give fertilizing suggestions, give pesticide and virus control suggestions as part of regular field inspections, and then buy back the seeds when they have been harvested. Farmers who often believe (or hope) that the entire process is insured, can be shocked to find themselves owing money to shops or seed agents in the event of crop failure. “Companies give different amounts but we working for Bayer are sure to give only what they promise,” explained Bayer representative Rupesh as he recruited farmers in a Ralledapalle *thanda*. “If 80% of the field is a loss and the farmer followed the instructions properly, they can receive up to Rs 20,000 per acre in that event.” In my own interviews, farmers (wistfully, perhaps) suggest that the correct compensation including inputs, seeds, electricity, and labor would be closer to Rs 60,000 per acre. Rupesh laughed: “if we gave Rs 60,000 for an acre no one would work, they'd just lie down on their beds.”

Farmers accustomed to doing ‘well enough’ with rice can find the high-risk, high-reward nature of hybrid rice agriculture exhausting. Dr. Ranitha suggested that after three years of instructions and inputs the farmers get fed up with the exorbitant investment costs and see that their soil has been damaged by excessive fertilizer and pesticide use. “The hybrid seeds are sold to other states and neighboring countries for commercial production, but they are useless in Andhra Pradesh where we have better tastes and are accustomed to [the taste of] thin rice.” The farmers tended to agree with her assessment. “A farmer will have one lakh (100,000) different kinds of problems,” offered Yakub, the male/female planting farmer. His friend explained:

> Each and every problem is a major problem, like spraying at a delayed time or aphids, things like that. Then the whole crop will be lost. The bullocks are important, the labor is important, the investment of even a single rupee is important. Chemicals are important. Selling is important. Weather is important. All are important. If anything is missed the farmer may face big trouble.

Even though farmers can earn as much as six times the rate for hybrid breeding rice that they earn for a thick rice like MTU 1001, the anxieties of rice commodity production can overwhelm the benefits of more income. With so much of the planting process directed by seed distributors, farmers often feel frustrated and resign management choices to those experts. That they do not know or care much what becomes of the seed they grow after the buyers take it is symptomatic of this knowledge imbalance. "If you don't follow their suggestions they know and give you a lower price for your product," warned one farmer. As with cotton, farmers direct their energy toward learning about more relevant information in hybrid rices – how to contact brokers, managing social connections to important resources like insurance contracts or machinery, or staying afloat amidst the inputs and experts that dominate hybrid rice management. Far less important are the seeds themselves and their management.

Sticky Knowledge and a Commodification Spectrum

Hippel (1994) uses the phrase "sticky knowledge" to refer to local knowledge, necessary for problem solving, that doesn't translate well to other contexts. Rice and cotton seed trials are themselves local efforts to find the best seeds, and so knowledge from seed trials should be sticky if they are to be successful. In the realm of cotton seed choices, seed trials in Telangana are particularly un-sticky. The first-hand knowledge of seeds and their trials is not only forgotten, it is replaced by the opinions of others, including local *pedda* farmers but also shop experts and successful farmers profiled in newspapers and television. Indeed, part of the appeal of following this 'unsticky' knowledge is its claim to legitimacy through being external – we as farmers do not know enough ourselves, but the *pedda* farmers, the scientists, the NGOs, or the lucky people profiled on TV can solve our problems.

Rice knowledge tends to be distinctly stickier, situated in the inverse market environment of cotton: fewer choices, more agreement about the agronomy of those choices, more experience with those limited choices, far fewer novice choices, and environmental response to widely understood seed qualities. These environmental differences resound in the social landscape, where experts and large farmers have little impact on the seed choices, where aggregate patterns reveal steady trends in seed choices, and vendors tend to be local and less predatory. The imperative to produce greater yields to keep up with greater costs is all-consuming in cotton agriculture, creating an environment where farmers copy their neighbors with the hope of staying abreast of the newest and best technology. With rice, knowledge is tactile: farmers feel their grains, inspecting for errant *beriki*, or nonproductive *kalthi* and *talu* as they plan their plantings around widely agreed-upon set of phenotypic variables. Yield is a consideration, but it is tempered by the needs of multi-generational plant health, seasonal suitability, and taste. This is especially true of OPV rice that can be saved like the 14 percent of rice seeds planted 2012-2014. Knowing that they can sink prices or ruin the next harvest, farmers carefully manage variations in plant form or grain shape, analogously unknown among the same farmers' knowledge of cotton GM hybrids.

As suggested in the section above, the exception to this is, of course, the hybrid rice seeds. Experts external to the farm determine hybrid management and so farmers shift the calculus of doing well enough with a reliable seed to optimizing their chance for a good yield with a hybrid seed. Most telling is the sharp difference in the number of years planted between OPV and hybrid rice. As with cotton agriculture, the reward structure of hybrid rice farming does not incentivize repeated planting and experience, but yield chasing. The incentives of planting a rice that cannot be saved and whose management is determined by a company representative begin to look like those of cotton growing. Simply getting by with these more heavily commodified kinds of germplasm is unacceptable.

The relationship between knowledge, management, and different kinds of seeds fits the pattern seen generally in Indian agricultural development (Gupta 1998; Vasavi 1999): as farmers adopt new agricultural technologies they also take on their associated management strategies and intersect with the social networks that sustain them. Recently, in cotton and hybrid rice these associated social politics have included direct company supervision and a concomitant lack of knowledge about specific parts of the production process. Commodity farmers do not need to know these things or do not practice a kind of agriculture in which they iteratively adapt this knowledge – if a Bayer employee solves a fertilization or pest problem with a test and a farmer learns that success in this crop means following that advice all the way to the input shop, that farmer will turn their attention to other matters. So why does this not happen in OPV rice? Why do many farmers settle for producing enough rice rather than striking out to find the best *manci digabatu* (good yield) as they so often do with cotton?

The relationship between managers, knowledge, and agricultural commodities on Telangana farms suggests a kind of commodification spectrum (**Figure 6.6**). On the most commodified edge are the experts and outside managers of plant stations and input companies working with cotton and hybrid rice. Management knowledge for hybrid rice and hybrid GM cotton, crops on this end of the spectrum, is the purview of those external to the farming household while farmers themselves are charged with being better consumers of technology, accountants, and marketers. Investments are high, necessitating high profits. On the other end are the wild, heirloom, or locally purchased varieties of vegetables, trees, ornamentals, and medicines that farmers intercrop with their cotton or cultivate on field edges.

Figure 6.6: Plant Knowledge and the Commodity Spectrum

Less commodified Knowledge more tactile Yield less important Branding less important	More commodified Knowledge less tactile Yield more important Branding more important

Crops	Vegetables, medicinals, flowers	OPV rice	Hybrid rice	Hybrid GM cotton
Average Years planted 2012-2014	7.46	4.93	.88	1.48
Branding	91% *desi* (heirloom)	Station/hybrid number	Brand names	Brand names
Brands 2012-2014	4	25	24	102
Role of Experts	Negligible	Consulted intermittently	Brokers consulted	Shops, brokers consulted
Saving	Almost always	Often	Rarely	Never

Source: Flachs Farmer Survey 2014.

Bt cotton field edged with okra adjacent to a rice field, itself edged by a forest area containing some widely used wild plants, including Neem (*Azadirachta indicaI* A. Juss.) and Gum Arabic (*Acacia Arabica* Lam.) trees.

Kavrupad and Ralledapalle farmers cultivate 13 and 20 such plants on their farms respectively (Flachs 2015). Of these, French marigold (*Tagetes patula* L.), pigeon pea (*Cajanus cajan* L. Huth*)* and tomato (*Solanum lycopersicum* L.) were the most commonly planted heirloom crops throughout the farmer sample. Among the 161 farmers who planted these crops, they planted saved seeds from the marigold, pigeon pea, and tomato for an average of 7.63, 7.48, and 7.28 years respectively. Farmers reported that 17 of the 398 non-crop plants were hybrid varieties while 364 were *desi*, heirlooms saved or bought from relatives or local vendors. Flowers were used for local festivals and cultivated competitively; tomatoes and pigeon pea were saved for their taste and their total production never measured or compared like the other crops. Their management and specific non-economic qualities of taste or beauty fell entirely within the hands of the farmers.

OPV rice lies in the middle of this spectrum, a semi-commodified good in a highly controlled and limited marketplace. Yield and economic payoff cannot be completely ignored or beside the point as they are in the non commodified flowers and vegetables. But they are not the be all and end all of rice agriculture. The relationship is complicated, depending on what each household decides they need and on their individual preferences. Experts tend to be local and consulted only when it is time to buy new seeds, such as rural shop owners and farmers rarely consult experts at plant science stations like Dr. Ranitha. Farmer knowledge persists in rice for all the social and political reasons that it fails to do so in cotton agriculture. Linking them across the commodification spectrum is environmental learning. When growing OPV rice, farmers still need to differentiate carefully between different seed varieties and between different plants in their field to make everyday cultivation decisions.

This chapter has shown that knowledge about rice seeds and rice management is more persistent than the knowledge of cotton agriculture because of the different ways that farmers navigate knowledge and reward for these crops. When farmers treat rice as a pure commodity and additionally surrender knowledge of the production process to corporate experts, the situation with rice knowledge begins to resemble cotton. Chapters 5 and 6 have discussed environmental and social learning as a function of the reward structure and inherent trialability of cotton and rice agriculture. Although these farmers interact with didactic instruction in the form of shops and extension agents, the following chapter discusses the social life of knowledge in the more extreme didactic form of organic farming. While many aspects of organic agriculture are directly regulated by organic instructors, these programs also rely on farmers to field test and locally modify certain elements of the production process (environmental learning) and to convince other farmers to follow their lead (social learning) and join the program. However, social and environmental learning are complicated in these organic schemes by the material incentives that subsidize the high costs of poor production and by the social capital that organic schemes invest in publicizing their farmers and their methods.

Chapter 7: Overcoming False Starts: Didactic Learning on Organic Farms in the Warangal and Adilabad Districts

The social politics of knowledge on GM cotton farms reflects the anarchic cotton market: great uncertainty, the oversized role of social emulation, agricultural deskilling (Stone 2007), and the undue influence of *pedda* farmers and agricultural authorities. The conditions by which farmers generally make agricultural decisions about GM cotton cannot be based in environmental learning as agricultural economists suggest because this technology is not trialable amidst noisy data filtered through the village hierarchy. Even large farmers with socioeconomic advantages become swept up in seed fads that they themselves kick off. In rice fields, those same farmers know more about the seeds that they plant, in part because they prize the same agricultural qualities when examining harvested seed that dealers seek when inspecting that harvest at the market. The knowledge that farmers create and adapt about this much smaller and more consistent set of rice choices is thus more predictable than knowledge about hybrid GM cotton. Environmental learning builds skill in this environment, where profit margins are less important and market demands more aligned with the qualities that farmers use to differentiate seeds. Although experts and institutionalized teachers inhabit their agricultural world these farmers make their cotton and rice choices themselves, even when that choice amounts to emulating a neighbor. This chapter discusses what happens when most choices are actively, institutionally, taken out of farmers' hands.

On organic farms where didactic learning becomes paramount, the creation of skill depends on the relationship between farmers and their sponsoring organic program. Unlike organic farms in countries with well-established markets and trusted regulatory apparati, Telangana farmers hoping to sell organic clothing cannot simply declare themselves to be organic and sell to foreign buyers or urban elites. Rather, they most often align with a development program that bridges gaps in marketing, regulation, quality control, and transportation between farms and buyers. Thus does organic agriculture require mutually beneficial social relationships between farmers and organic programs if it is to last. On organic farms where cotton seeds are provided, farmers may sometimes carefully evaluate the differences between seeds. But that evaluation is meaningless because farmers are obligated to take non-GM seeds provided by the program in the following year as well. When these and other production risks are underwritten by the organic program, especially for those farmers on whom the program depends to provide a good face for visitors, these organic farmers have no need to conduct seed trials that generate environmental knowledge. In other technologies, such as IPM cultivation, organic pesticides, or organic fertilizers, the staying power of the technology depends on a shifting calculation of labor, support from the institution, costs, and benefits. Such interventions may be easily trialed but still require social commitment if they are to continue beyond the direct instruction that occurs during didactic farmer field schools. IPM practices in one village ended the day the instructors left, largely because the farmers found that Bt cotton accomplished many of the same goals with a fraction of the effort. In a different village, they continue because the NGO provides continuing support and allowed the initial instructions to evolve as farmers developed easier or more effective methods.

The roadsides of rural India are littered with the false starts of such projects. Within anthropological development literature, the unintended consequences of development projects and the short life-span of alternative development initiatives can fill libraries. Described most eloquently by writers like James Scott (1998) or James Ferguson (1994) such development initiatives promoted by states or NGOs often destabilize effective local economic or ecological management by imposing impractical rules. While failing to provide their ostensible economic benefits, these programs often bring development subjects into closer relationships with the state. Recipients of such development might provide lip service to new institutional rewards and punishments, or they may find their situation unchanged after the development apparatus loses interest and moves on to the next project. This chapter is concerned with the strategies that farmers and NGO managers develop to keep donors and cotton-growers engaged in these projects over the long term. Specifically, I examine the ways in which farmers develop knowledge that allows them to adapt organic agriculture tools to local economic and environmental demands. Similarly, I also consider the ways in which organic programs keep farmer interest in a market overwhelmingly dominated by Bt cotton cultivation.

Within organic programs, the problem of false starts trigger bad press later in the production chain. In one well-publicized scandal Swedish clothing manufacturer H&M sold fraudulent organic clothing revealed to contain Bt cotton. The resulting inquiry, led by Germany's *Financial Times* revealed that a as much as 30% of certified organic cotton from India contained Bt genes, leading to charges that H&M was cutting regulatory corners and that India was not to be trusted (Chua 2010; Deshpande 2010; Illge and Preuss 2012; Graß 2013). In that case, H&M's attempts to separate itself as a socially responsible supplier backfired when reporters and their echoes on fashion blogs accused Indian distributors of providing GM cotton to unsuspecting German consumers. Without the support of such lucrative foreign markets, organic cotton initiatives would have to shut down. As pathways to foreign markets shut down, so too would the booming Indian organic production, accounting for 74% of global organic production in 2011-12 (Textile Exchange 2013). In response, H&M and Indian regulators redoubled their efforts to crack down on fraud. The different strategies by which these farms and programs make organic agriculture effective reveal both their promise for long-term sustainability and the folly of assuming that these strategies are generalizable to the larger phenomenon of organic agriculture in India or worldwide.

In this chapter I draw on the experiences of farmers involved in two different kinds of organic projects. This difference is important, as I argue in this chapter that organic programs with different institutional demands behave differently. To generalize about all organic agriculture because of the experience of one type of organic program ignores the larger reward structures that drive regulation, agricultural decision-making, and, ultimately, the social politics of knowledge. Both of the organic programs that I studied worked with entire villages as a way of discouraging fraud and building up a village brand for organic consumers. Edaggrineelu, in the Warangal district, is an uncertified organic village. As such, trust in Edaggrineelu products comes not from a certification agency but from PANTA, a Hyderabad-based NGO that directly markets to urban consumers. Edaggrineelu farmers also sell in the conventional market in nearby Jenagom. Because of this structure, Edaggrineelu farmers depend on PANTA for logistical and marketing support. For its part, PANTA depends on Edaggrineelu farmers to promote themselves to visitors and donors.

The Japur and Adilabad clusters of villages in the Addabad district work with Prakruti organic, a certified organic corporation. Their authority comes through an internationally recognized organic label that has paved the way for international partnerships with clothing companies based in Europe, Japan, and the US. While Edaggrineelu earns trust through performance and assurance, Prakruti villages earn trust by passing regular inspections. This is not to say that Prakruti-affiliated farmers are not frequently called upon to perform for visitors.

They are indeed regular performers. However, this performance is less in the service of building a brand, as in Edaggrineelu, than in securing the support of specific buyers and donors.

Didactic Learning and the Commodity Biography

In the Warangal district villages of Kavrupad, Gongapalle, Srigonda, and Orukonda, the *pedda* farmers growing Bt cotton make use of didactic learning opportunities. Not only does the rest of the village look to these farmers for their seed choices (even when there is no yield reason to do so), they are also wealthier and connected by caste to farmers in the extension services. As discussed in chapter nine, some *pedda* farmers, particularly in Srigonda, work with friends in the extension programs to gain new methods and tools at a subsidized rate. In Kavrupad, Gongapalle, and Orukonda, local alternative agriculture schemes are targeted at friends of university professors and breeders, who choose caste relatives, especially members of the high caste Rao and Reddy groups, as early adopters of this new technology. Thus, didactic education through extension is added to the social and environmental learning used by large, high caste farmers.

The situation is very different for many organic projects, including the three villages where I worked with organic farmers. Prakruti and PANTA affiliated farmers were specifically chosen because of their low caste, poverty, poor relationships with agricultural extension, and marginal land. Their poverty and marginality is part of what makes them attractive to urban or foreign consumers in the first place, adding value through what Franz and Hassler (2010) call the commodity biography. Much of the added value of organic cotton is not its health benefits to consumers but its promise of an improved environment and life for Indian farmers – the more marginal the better. Thus is education and crisis aversion the proximate cause for organic education programs: value added organic cotton consumption supports education and improvements for the farmer. This connection, however contrived, helps forge a story that justifies extra costs and keeps buyers or donors engaged with these projects.

Igor Kopytoff (1988) famously referred to commoditization as a process to highlight the ways in which culture defines how and when commodities become culturally marked as particular types of things (Kopytoff 1988:64). For Kopytoff, the cultural biography of a commodity provided a means of illuminating the various social relationships that produced, alienated, and consumed the thing in question. The thing's social status as a commodity in different times and contexts, interpreted by different populations, gives rise to its biography: the different social roles that a commodity plays throughout its life. For organic cotton consumption, especially in major cities like Hyderabad or abroad in Japan, Europe, and the United States where Edaggrineelu and Prakruti-affiliated farmers sell their wares, labeling and branding does the work of cultural marking. In Kopytoff's terms, labeling emphasizes a particular aspect of the commodity biography, namely its production. Following this logic, Guthman (2009) argues that labels like the Fairtrade and Organic stickers affixed to Prakruti clothing or the Edaggrineelu brand serve two purposes. First, they differentiate commodities in the store, emphasizing the links of production in cotton's long and complicated supply chain that are hidden by mass textile marketing. Consumers buy a labeled shirt because they buy into the lives of growers, ginners, and clothing manufacturers and trust that the label guarantees a degree of fairness. Such desires have been shown to be powerful motivators for both growers who want to get ahead and consumers who want to buy into morally good products or support morally correct production (Benson and Fischer 2007). Second, the act of unveiling the commodity fetish, that is, using a label to reify links between producers and consumers, is itself an added value. The act of labeling makes the label a consumable commodity even as it is designed to combat the alienation of labor and natural resources through the supply chain.

The correct balance between adding value through the commodity biography and providing a viable product can be difficult to reach, even at the highest levels of cotton corporations. "What is the advantage of tracing it back to them? What value does it add," asked Bindu Gugothal of Fairtrade UK. Gugothal visited Hyderabad to meet with representatives from Prakruti and to check in on producing farmers. Like many ethical supply chain companies, Prakruti leans on the authority of the Fairtrade label, which affirms that Prakruti products were produced by people paid a particular wage, without child labor, tend to have an institutional return to farmers (such as a cooperative buying and selling structure), and encourage environmental conservation practices. These environmental rules can, but do not necessarily, include organic certification. More important for Indian cotton, Fairtrade bans the intentional use of GMO products. Thus to get non-GM seeds, most Telangana Fairtrade farmers would have to be part of organic programs anyway. Fairtrade products, running the gamut from gold to quinoa to clothing, carry a label certifying that Fairtrade meet a set of standards as detailed in audits and other reporting. To incentivize alternative production, Fairtrade also offers a price premium to farmers, reflected in a higher consumer cost.

Part of the Fairtrade process involves regular check-ins to answer concerns from producer companies, audit the supply chain, and collect information that can be used in marketing and certification campaigns. About once a month, visitors from foreign companies or campaigns, Fairtrade included, visited Prakruti facilities on fact-finding trips to meet the same organic farmers I had been interviewing so that they can learn more about their producers. The narratives, stories, experiences, photographs, and videos that they gather while on the ground in

India help to inform the conspicuous consumption or awareness that international groups including the World Bank and Japanese clothing companies hope to foster.

As a cotton marketer, Gugothal's main responsibility is in justifying costs and campaigns to buyers. "It's a story for a product, that's what I'm saying," answered Prakruti CEO Ashok Chender, referencing to a unique UK-based buyer who manufactures single garments sourced from individuals.

> Not all products can bring that story. But for [UK buyer] Ben, it's a very good story because Ben's pants are not cheap. A twenty pound pant is not cheap. So he's competing with a five pound pant, and on what basis? One, the quality is extremely good, I don't say his quality is bad. Having said that, he is actually saying [UK clothing company] Pants to Poverty is traceable, its actually addressing poverty issues on the farm. And this is what I do. And so I think people buy it for that. But the same set of people if they go to a Marks and Spencer may not buy that. They may not be interested because they are looking for a five pound shirt.

For organic cotton corporations, who cannot hope to compete with the low costs of the conventional fashion industry, shaping and selling the commodity biography is key to staying afloat in the market. The organic cotton commodity biography, seized on by manufacturers like the one described above, is defined by development and agricultural education.

Organic labels or brands allow marketers to emphasize an aspect of production that organic consumers particularly want to support. This desire for development sets the conditions for didactic learning. Organic cotton sales from the Prakruti and Edaggrineelu farms are predicated on the trust, guaranteed by the village brand or certifying label, that these more expensive clothes contribute to a better life or to development for the farmers in question. By buying organic clothing, wearing it as a form of conspicuous consumption, and donating to the NGOs that market it, consumers buy into the kind of development that produced these commodities. This narrative, that clothing consumption helps to empower or improve the lives of particular people, sustains development programs. Speaking of organic peppercorn farming in Kerala, Franz and Hassler (2010) argue that "German buyers are willing to pay a premium for the pepper because it is certified organic, but also because of the cultural and social embeddedness of production…The added value of the 'story', and the knowledge of the fact that this biography actually adds value to the product in the market, allows a shift within the power structures of the network (Franz and Hassler 2010:32)". Franz and Hassler argue that this need to connect with the Kerala pepper farmers actually returns some of the power in a global production network to agricultural producers. In the case of these Telangana organic programs, the need to connect to poor farmers participating in a particular kind of development creates obligations between representatives of the program and the farmers themselves. Materially, these obligations manifest in incentives programs and media used to promote the programs. Socioculturally, these obligations are filtered through extant village hierarchies and the shifting relationships between farmers and program directors.

In a didactic learning environment such as a farmer field school or an organic workshop, the learning process becomes the most relevant part of the commodity biography: teaching farmers according to organic, Fairtrade, or other branded standards. As such, this story is carefully constructed by emphasizing certain parts of the production process (like non-GM seed) and choosing particular groups of people to grow it. The system is built on a series of interrelated trusts. Farmers do not plant GM cotton, they live better lives, and the clothing companies allow consumers to support this improvement. As H&M discovered, failing to keep this trust at any stage of the production process can be damaging to the brand as a whole. This is not to say that the communities are fraudulent or imaginary, but that their participation and success is built on maintaining a narrative that capitalizes on their poverty and initial ignorance. If the farmers were already rich and well-educated, there would be no need for the development initiative.

The Prakruti and PANTA organic programs began from the assumption that farmers were in crisis, drawing on the longstanding model (Ferguson 1994) of crisis of poverty and isolation that justifies intervention. "We choose only the rainfed areas" explains Prakruti program manager Sama Vallatha when I asked why all of the farmers that I met lived on marginal land or belonged to historically marginalized social groups. Sama continued:

> We work with cotton farmers mainly where there are high suicide rates. So that is one thing. And we mainly focus on rainfed areas so these are the two things we see. So, if we see suicide rates like, it's a high area so we know we will be working there. Adilabad is close to there and it's in the cotton belt, so we are working there. But specifically within Adilabad we are working with Tribal farmers. But in other places we work with other farmers… These people they don't have access to resources actually. So, in a way they're resource poor farmers, compared to other farmers in the main places where they have access to marketing and all. So these people face a lot of exploitation. We want to address the issues related to these problems.

Similarly, PANTA' program in Edaggrineelu was born of a response to a particular pest infestation and expanded over time to incorporate other elements of production. Both programs have since grown and connected with government schemes as well as foreign and urban buyers. Drawing on the narrative of suicide and agrarian crisis widely reported in India (Galab, Revathi, and Reddy 2009; Sainath 2013; Parsai 2012), these and other NGOs positioned organic agriculture as an alternative to the corporate-state model of production that favored centralized production using agricultural chemical inputs and seeds (Pearson 2006). By selecting marginalized people and marketing textile consumption as a development tool, these organic cotton programs make the didactic learning experience central to consumption. This section has explained the ways in which organic programs build a commodity biography that necessitates didactic learning to appeal to consumers. This appeal keeps buyers engaged but because these people are often the farthest removed parties from production, they have the least direct influence on overcoming false starts in development. The following section shows how these programs incentivize didactic education for farmers.

The Problem of False Starts and Incentivizing Instruction During Didactic Learning.

As discussed in chapter three, didactic instruction in India dates to the industrial colonial period. Beginning with an increase in Indian cash cropping during the American civil war in the 1860s (Beckert 2014; Guha 2007), accelerating with the Green Revolution (Gupta 1998; Vasavi 1999), and continuing with GM and organic schemes, didactic instruction has been crucial to Indian agriculture. In each instance, a network of agricultural experts, local managers, and textile consumers set a series of conditions in which farmers create and adapt knowledge. Initially, Green Revolution learning was strongly didactic in the sense that it was pushed by extension agents and carried the weight of moral progress with it. However, the interconnection of state or international funds and the economic benefits of a vertically integrated agribusiness led Green Revolution-style agriculture to quickly dominate production (Kloppenburg 2004; Perkins 1997; Ross 1998). In addition, didactic Green Revolution agriculture worked especially well for influential larger and richer farmers (Shiva 1993), helping to make the system of shops, subsidies, inputs, and extension services the 'normal' way to farm in India. Didactic learning gave way to social emulation and first-hand experimentation as smaller farmers aimed to copy the success of their larger neighbors, a pattern that would be repeated with organic programs.

The process of bringing organic farmers into alignment with international standards and initiatives that market their marginalization as a selling point similarly begins with a didactic push that gives way to social and environmental learning. In Edaggrineelu and on Prakruti organic farms, as well as in other organic and NPM training programs in South India (Eyhorn, Ramakrishnan, and Mäder 2007; Mancini, Van Bruggen, and Jiggins 2007), development programs working in a new area first endeavor to choose influential farmers. Their backing helps to build rapport in villages, which tend to be chosen because they are poor, isolated, or otherwise in need of development in the first place.

All of this infrastructure can be difficult to set up and maintain. Glenn Stone (2014) recalls Yakub, a farmer near Kavrupad extolling the virtues of his integrated pest management (IPM) methods. The same farmer had discontinued these practices only a few years later once support from his sponsoring didactic organization dried up. In the area, nearly fifty farmers came and saw his work. After speaking with him, they too adopted IPM farming. But by the time I met Yakub in 2012, he was planting fad Bt cotton seeds Dr. Brent and Neeraja. “Initially IPM was less expensive,” he explained sheepishly, “but the overall cost and needs of Bt cotton were even lower”. Mancini et al. (2007) conducted a successful NPM training program well-liked by participants in Srigonda. But, a few years later, farmers had stopped following most of the intervention’s advice as well. The ways in which farmers navigate these and other interventions designed to improve agriculture will be explored more fully in chapter eight and chapter nine. However, these false starts provide the context for the didactic organic programs that I saw, which endeavor to work with farmers over a longer period of time. When farmers and program managers fail to maintain organic management through the cotton supply chain, the resulting miscommunications can cause serious problems for clothing retailers, as H&M

discovered. The question is thus one of sustainability: how to keep up didactic intervention that appeals to consumers, farmers, funders, and managers?

By definition, these projects begin with a didactic push. In the case of Edaggrineelu, particular farmers sought out expert help and developed a relationship. On the Adilabad district Prakruti farms, as well as among the IPM, NPM, and expert consultancy services, development initiatives seek out farmers who may be interested in their programs. During this initial phase the stakeholders feel out the costs and benefits of the burgeoning alliance: farmers must be convinced that the program will provide them real and tangible benefits; NGOs carefully document these classes to appeal to funders and secure future projects; other villagers watch to see if their neighbors participating in the program appear to be benefitting; donors and managers abroad or in urban centers rely on NGO-generated and news-generated media to see that their directions and dollars are being put to good use. Early on, organic programs publicize their efforts within the village. A large cistern in the center of Edaggrineelu lists sixteen rules for organic production while Prakruti erects signs and murals celebrating the benefits of organic farming. These displays list economic benefits, but they also remind farmers how much better organic agriculture is for their children, their health, and for the stewardship of the land. They also make excellent photographic backdrops.

Organic signage, Left to right, top to bottom: Cistern with organic guidelines; Welcoming sign for Edaggrineelu village; Sampalle sign with sponsors and organic requirements; Japur mandal sign proclaiming that Prakruti farm children are well cared-for.

Farmers learn a great deal during such interventions, ranging from vermicompost management to companion crops strategies to attract useful predatory insects. Farmers may or may not already know how to implement some of these methods, but the schools provide a refresher course and typically supply necessary equipment like bricks, seeds, or plastic drums. As should be expected from didactic instruction, these raw materials and demonstrations are accompanied by moral and economic reasons to abandon conventional agriculture. Subash Palakar, founder and barnstorming promoter of the alternative permaculture-based system Zero Budget Farming, praised the yield and income benefits of his intervention at a rally in Warangal city. But, like the branding of PANTA and Prakruti, his pitch was as didactic as it was practical:

"We have become accustomed to fixing problems only with these chemicals," he warned. "Just as women are taken in by cosmetics, we farmers are being taken in by brokers, consultants, and chemical inputs." The audience nodded in agreement as he disparaged foreign knowledge sent from Europe and the US during the Green Revolution and joined him to celebrate native Indian cotton seeds, native breeds of cows, and the life-sustaining power of Indian Neem (*Azadiractha indica* A. Juss.) or Indian yogurt. "Abandon the foreign Jersey cow," Palakar lectured. The crowd cheered. Farmers leave such programs with new enthusiasm and new knowledge about the potential of these methods.

The didactic pushes of organic programs by Prakruti or PANTA were not so nationalistic, but farmers were receptive to the idea that they could earn more by buying fewer inputs and selling outside of the normal commodity markets. However, the initial push itself is not sustainable in the sense that infrastructure alone is not sufficient to convince farmers to continue with the program beyond the length of the field school or the incentives. As the faded murals and crumbling rice mill built by a Kavrupad NGO attest, didactic instruction must shift into the environmental or social realms by which farmers generate knowledge if the alternative strategies are to be sustained.

Faded NGO mural advising farmers to use non-chemical inputs and non-pesticide methods.

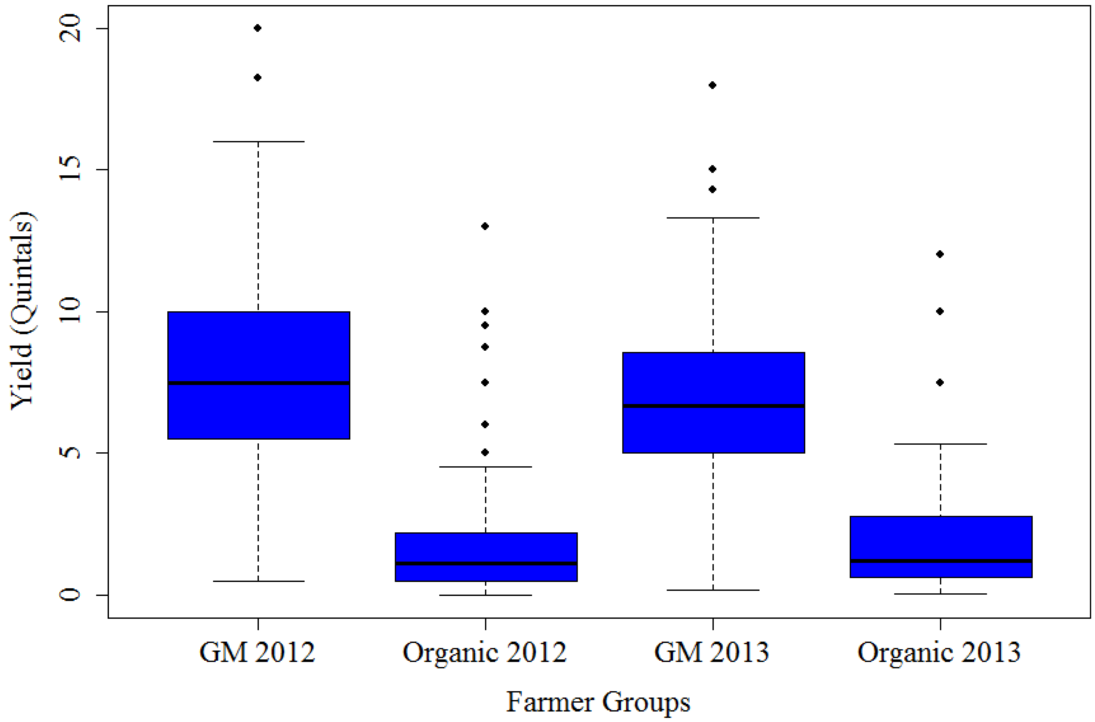
Initially, didactic programs struggle with motivating or recruiting potential farmers. Incentives like a free meal (offered to farmers participating in Palakar's seminar), expertise with particular problems (offered to Edaggrineelu farmers), or natural pesticide-mixing drums (offered to Prakruti farmers) can draw farmers in for a season. But to entice farmers to stay beyond the next round of pesticides and Bt seeds, didactic learning must transition into environmental learning, in which farmers develop working strategies that improve their yields or profit margins, or into social learning, in which farmers can emulate a good model. For Edaggrineelu farmers and Adilabad district farmers affiliated with Prakruti, intervention programs targeted didactic instruction not at the village as a whole but at particularly influential farmers. This strategy correctly saw that information and social learning are mediated through the village hierarchy. The earliest alternative farmers and most vocal local champions in the villages where I worked were local political leaders and influential landowners.

The rules of caste hierarchy that dominate Telangana villages discussed in the previous chapters are not directly applicable in low-caste Edaggrineelu or Prakruti's tribal Gond villages of Addabad and Japur in the Adilabad district. However, interventions targeted larger and wealthier landowners with the hope that their support would ease the way for the program in the larger village. "You see, he's a very knowledgeable person and a good leader who could mobilize the village so we always feel such charismatic leaders are important," explained SUS Executive Director VG Ramesh when I asked about a particular Edaggrineelu farmer, discussed in greater detail below. "Most of the people in the village trust us because of Mahesh." Using these influential people as initial ambassadors to spur social learning, organic programs are able to spread to entire villages. This is more convenient not only for organic project managers, who can work with fewer farmers at a time, but also for visitors who can see the village through the eyes of a helpful interlocutor. Once converted to organic production, such villages receive funding for schools, signage celebrating their fully organic status, and media attention calling them model villages. However, the promise of these social and material rewards is not always convincing enough for cotton farmers.

Even with charismatic leaders who can translate a didactic learning experience into the more long-term social or environmental learning that farmers regularly employ on their farms, organic agriculture suffers from yield problems. There are several problems directly comparing organic farmer cotton yields with the rest of the sample. The organic farmers were recruited because they are more marginal and live on more marginal land, so one should expect them to have lower yields anyway. Additionally, I did not speak to any GM planting farmers in the

Adilabad district, and so while the agronomic conditions are similar to Warangal farmers they are not exactly comparable. These caveats aside, the average differences in yield are stark (**Figure 7.1**). Organic farmers in the Adilabad District and Edaggrineelu are well aware that their yields are below those enjoyed by their pesticide-spraying, Bt cotton planting neighbors. During one interview with a Prakruti farmer, a neighbor driving a motorcycle stopped to tease us. "Why are you asking about their farms," he asked me. "With [Bt cotton seed] Ajeet-155 I am getting much better yields than these people. Besides, with this organic production you have to spend time at many meetings!" Stung, the farmer I was speaking with countered, "Those with money can afford to use GM seeds and make large investments." The neighbor rode away, but not before bragging about his recent impressive harvest with Bt cotton and the pesticide Missile. Didactic instruction may help farmers feel better about their planting choices or convince them that these choices are correct, but that active instruction can only last so long in the face of economic failure or social jousting. With such low yields, why do farmers not simply leave the programs that I studied?

Figure 7.1: Boxplot of Cotton Yields per acre per Household of Organic and GM Farmers



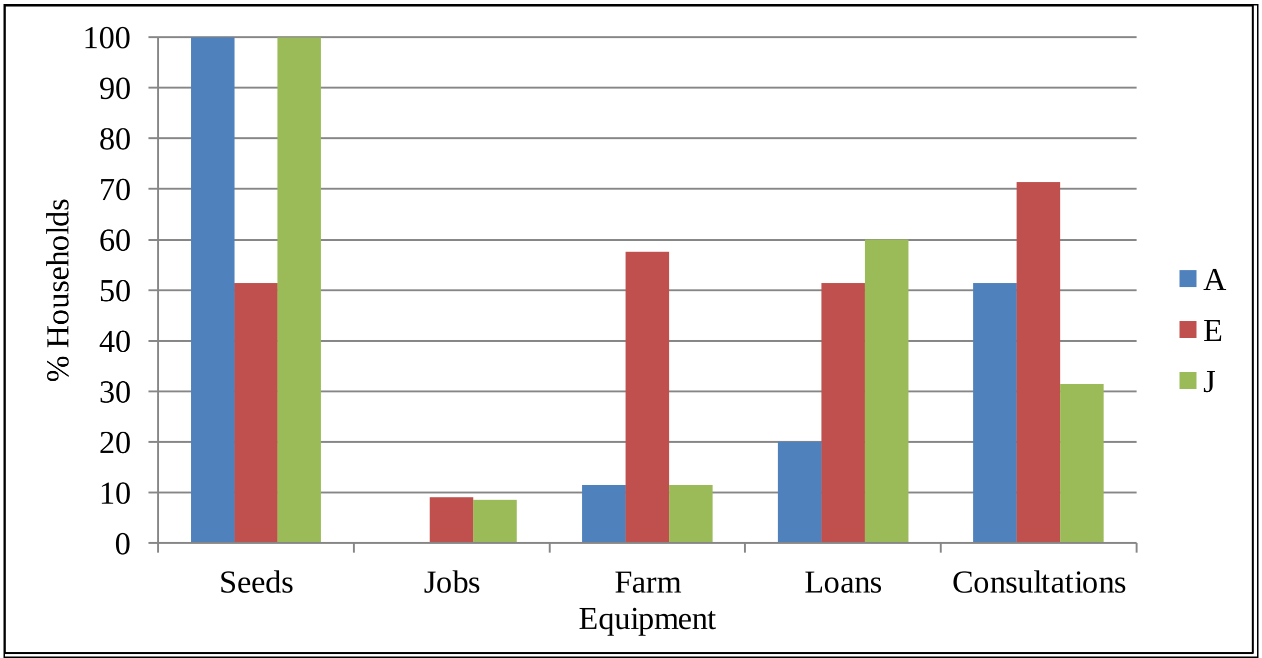
<u>Descriptive Statistics</u>

	2012 GM	2012 Organic	2013 GM	2013 Organic (only Prakruti Farmers)
n	293	98	226	94
Mean	7.64	2.00	7.06	2.45
SD	3.66	2.38	2.78	3.90
Minimum	0.50	0.00	0.17	0.02
Maximum	27.5	13	18	40

In each year, these differences were statistically significant at $p < .001$. Source: Flachs Farmer Survey 2012-2014.

To counteract low yields, the incentives that underwrite the costs of production must be sustained as well. In fact, many farmers in the village benefit from equipment, seeds, and access to government schemes (**Figure 7.2**). In 2012 and 2013 in these organic villages, organic programs provided access to a huge percentage of the seeds that farmers planted. 100% of Prakruti farmers receive free seeds, for example. In doing so, programs save farmers money and time as many of these villages are at least 40 minutes and a 50-100 rupee round trip transport fare from the nearest store. Like typical seed shops, the organic providers give seeds on credit. Unlike those shops they provide credit at low interest or often no-interest return rates, and programs provide more wiggle room during repayment than the shops. Such shops are additionally hostile to the organic farmers in villages like these because they are populated by people of lower castes or who belong to a tribal community that has faced historical disenfranchisement from the caste majority in the town – a status used in international ethical marketing. Given that more 90% of the cotton planted in India is genetically modified, programs realize that they must provide the seeds they want farmers to plant. In addition to seeds, many farmers also secure equipment or loans through these programs. While the government has a number of schemes designed to appeal to farmers, the inefficient and sometimes inept bureaucracy can be difficult to navigate for individual small farmers. Organic intervention programs step in and do the paperwork, as it were, providing the last steps necessary to connect farmers with money or infrastructure that they are eligible for. This helps to underwrite the risks of doing a method with which they are unfamiliar, especially at first, and even underwrites the fact that yields are relatively quite low for these farmers.

Figure 7.2: Percentage of Households Receiving Material Benefits from Organic Programs 2012-2013 (n = 101) for Addabad (A), Edaggrineelu (E), and Japur (J) villages



Flachs Farmer Survey 2013.

Farmers who can take advantage of these programs turn didactic learning into a material safety net against these low yields. In Edaggrineelu, the Adilabad cluster of villages, and the Japur cluster of villages, the initially recruited farmers are called upon to help enforce organic methods and work with others to demonstrate new techniques. Out of necessity, they must learn to use the skills from training exercises whether they ultimately use them in their fields or not. Many organic farmers report that homemade pesticides are difficult to produce, and I can attest that the fermented concoctions of cow urine and leaves smell terrible. Rather than learn to produce these pesticides themselves, most members in the village rely on the zealous early adopters to produce the pesticides and distribute them, although they may assist in gathering the resources necessary (especially if visitors are present to document the experience).

In exchange for these incentives, farmers in the three organic villages I visited were asked to use a suite of alternative agriculture methods to improve soil quality and control pests

(**Table 7.1**). Each method was taught through a demonstration session. Although farmers initially claimed that they followed didactic advice without modification, subsequent interviews and field visits revealed that the rules for these alternative strategies were so general that they could be easily modified depending on the needs at hand. Leaf compost and animal fertilizers are smelly and do not necessarily need to be applied each year – this is a function of farmers checking their soil for moisture and fertility evidenced by plant growth and soil texture. Other methods, like light traps or drip irrigation, depend entirely on what the program provides.

Table 7.1: Counts for Alternative Input Strategies on Organic Farms 2013-14, n = 101

Method	Fertility	Insect	Water	Row Total
Animal fertilizer	100			100
Cow urine		3		3
Drip irrigation			4	4
Green Compost	21			21
Lake Soil	31			31
Leaf-based insecticide	1	92		93
Light trap		1		1
Neem application	2	30		32
Nitrogen fixing plants	2			2
Pipe irrigation			5	5
Plastic box trap		3		3
Water conservation		1		1
System of Rice Intensification (SRI)			21	21
Trap plants		12		12
Vermicompost	35			35

Flachs Farmer Survey 2013-2014.

While the programs sponsor demonstration sessions and meetings, provide spaces for demonstration farms, hold workshops, and fund numerous small farmer field schools, these interventions can be short-lived, as in Srigonda or on Yakub's demonstration farm. SRI provides an instructive example of a method viewed by farmers with skepticism. SRI was a popular and publicized method in 2013 in Edaggrineelu, but farmers were beginning to complain that it required too much work: "We need to have full awareness and work in the nursery," complained Edaggrineelu SRI farmer Srinu. "It's like looking after children. You have to add water three times a day in the nursery, spread the vermicompost, make rows and paths when transplanting, transplant early and exactly in the ordered lines, keep an inch of vermicompost, mulch it for the shade, and have a lot of time and patience for the weeding. It takes a day to weed an acre!" Although Edaggrineelu farmers agree that SRI gives greater yields, the extra work does not appear to justify this method. This may be in part because, as discussed in the previous chapter, many farmers are satisfied when rice yields 'enough', and do not try to maximize yields in the same way that they fight for yield with cotton. Another Edaggrineelu farmer balked at having to do rice work himself: "I planted one acre of SRI rice last year but only because my son was here to push the weeder and do the hard work of it. It's just not worth the effort otherwise. I planted half an acre this year and while the yields are good from SRI, [myself and my wife] have no interest in pushing that machine. Our son does all of that kind of work as no one else wants to." Recognizing that social learning is a powerful tool because of the staying power of reliable members of the community, all three of the organic villages use didactic learning as a tool to kickstart social learning that keeps farmers engaged and in line with organic regulations. As other farmers lose interest in the method, those initial adopters can then be tasked with demonstrating it to give the impression that all villagers are so engaged.

Similarly, the demands of village meetings, self-help groups, and cooperative planning sessions fall to the most enthusiastic farmers. Others are happy to avoid this time-consuming work. "I'm not educated, how can I go," complains Prakruti farmer Mankarao. "In group meetings, everyone else explains what to do, especially the sarpanch[21] and the educated farmers." "We don't go to meetings, they're far away - others go and report back to us," agreed

[21] The local elected village leader and liason to mandal authorities

his neighbor Shararao. Such farmers are, as a rule, uninterested in going to meetings and participating in tours or lengthy training sessions organized by the organic groups, who in turn recognize that many of their farmers are happy to participate but not evangelize for them. To fertilize their soils, they must maintain vermicompost, green manures, and livestock, all of which they have been trained to use; to keep pests away they must use a series of homemade organic potions that they have been trained to make. But after the initial demonstration phase, these farmers can buy these organic inputs. Most organic farmers appear content to view the organic program as an improved version of the input shops, albeit one that offers a limited choice in products.

Despite these limitations, farmers continue to conduct trials and look to their neighbors when evaluating cotton seeds. This effort yields mixed results. Prakruti farmer Anil, for instance, planted the cotton seed Mallika in 2013 but remembered that Bunny had been good in the past and saw that his neighbor did well with it the previous year – an example of a direct observation of yield payoffs. In 2014 he planted both to see which would be better in his field. By his recollection, Bunny is smaller and has fewer bolls than Mallika. His neighbor, Allaram Srirao, is copying those choices because Anil is an experienced organic farmer and a Patel, meaning that his family owned many acres and was socially important in the past – an example of a prestige bias influencing social emulation. Fourteen of the Prakruti farmers followed suit, planting both of the organic seeds offered in 2013 or 2014. Others, like Ponam Albarao sought out Mallika on the recommendation of his neighbors, but because that seed had sold out by the time he joined the program, he planted Bunny. "So far, it's growing fine," he offered noncommittally. "We have to wait for the harvest". They are free to make careful environmental observations about the cotton seeds that they plant, but the payoff for this is unclear. Organic farmers must buy through programs or their shop affiliates, which provide the only source of reliable non-GMO seed. These seeds are sometimes sold to farmers at favorable prices, but more often they are provided for free due to various government and NGO subsidies. During 2013 and 2014, farmers in these villages only had access to two seeds through organic vendors: non-Bt Mallika and non-Bt Bunny. Prakruti and Edaggrineelu secure these seeds from the refugia stock of the Nuziveedu company. Environmental learning is unnecessary as farmers have no real need to trial their seeds or methods because the NGO has an active interest in helping the farmers solve their problems and keeping the program attractive to them.

For these farmers, organic agriculture is low-risk. However, it does not help them build a reliable knowledge base because the limited seed choices encourage them to over-rely on social emulation of local leaders and didactic instruction from their programs. Rather than careen from seed to seed, organic farmers instead are blessed with an embarrassment of useless knowledge – they know about methods and seeds that they have no choice in using and cannot stop using unless they leave the program. If they fail to uphold their end of the bargain with the organic program directors either by breaking rules or refusing to pay back loans, or if they choose to leave the program, they are just as lost as small GM farmers because they have not yet had to navigate the seed market.

Yet just as larger farmers were able to turn some aspects of the new cotton market to their advantage despite unpredictable GM seeds, some farmers are using the organic program as one wellspring among many rather than their sole source of agricultural skill. For some farmers, this means working closely with the NGOs as a show farmer and thus best positioning themselves to trial new methods at low risk and with help from the NGO. Ironically, for others, it manifests in strategies where farmers cautiously practice organic and non-organic agriculture.

The Role of Show Farmers in Jumpstarting Learning on Organic Farms

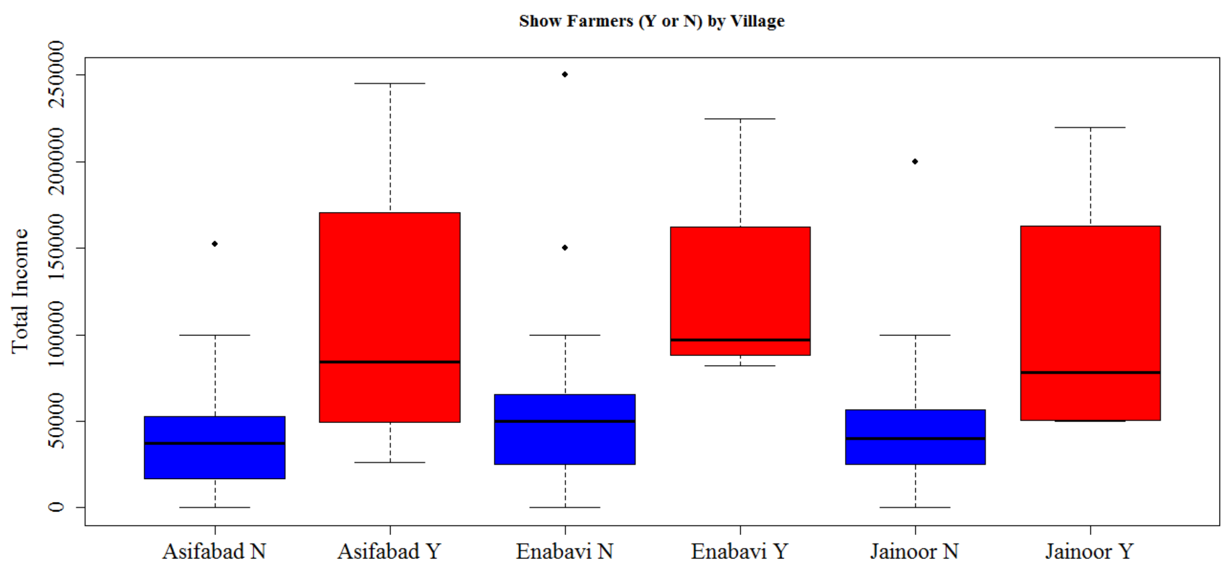
I will discuss the category of organic show farmers, those who actively perform and profess their organic transformation for NGOs and visitors, in greater detail in chapter 8. I invoke them here to show how their demonstrations reduce agricultural risk, help them avoid overreliance on scheme knowledge, and how they teach others in the village about program guidelines. Show farmer refers to a category of farmers most involved with the programs, who work closely with program workers and leap to demonstrate their methods to visitors and other farmers. Either because they are especially charismatic or because they are especially good farmers, these people get the benefits of the newest trainings and farm equipment.

Show farmers are often early adopters who develop relationships with the organic programs over time. Those closest to the program learn how to make and use the pesticides, taking into account local variations in leaf or cow potency. They are also better educated and wealthier (**Figure 7.3**), meaning that they have more flexibility to try new products and experience less social distance when working with foreign visitors or NGO experts. In each village, I identified four show farmers through ethnographic data including qualitative participant observations and interviews. The farmers I chose were those selected for demonstration plots, asked to meet with visitors, were more involved with the intervention organizations, were those identified by program officers as helpful people, and were farmers who emphasized their role in the program during interviews with me. They were, in short, the farmers most invested in showing off the farm to visitors and to other farmers. My criteria are therefore subjective but centered around those farmers who most embraced or embodied the qualities of the show farmer. Show farmers are more fully analyzed in chapter 8.

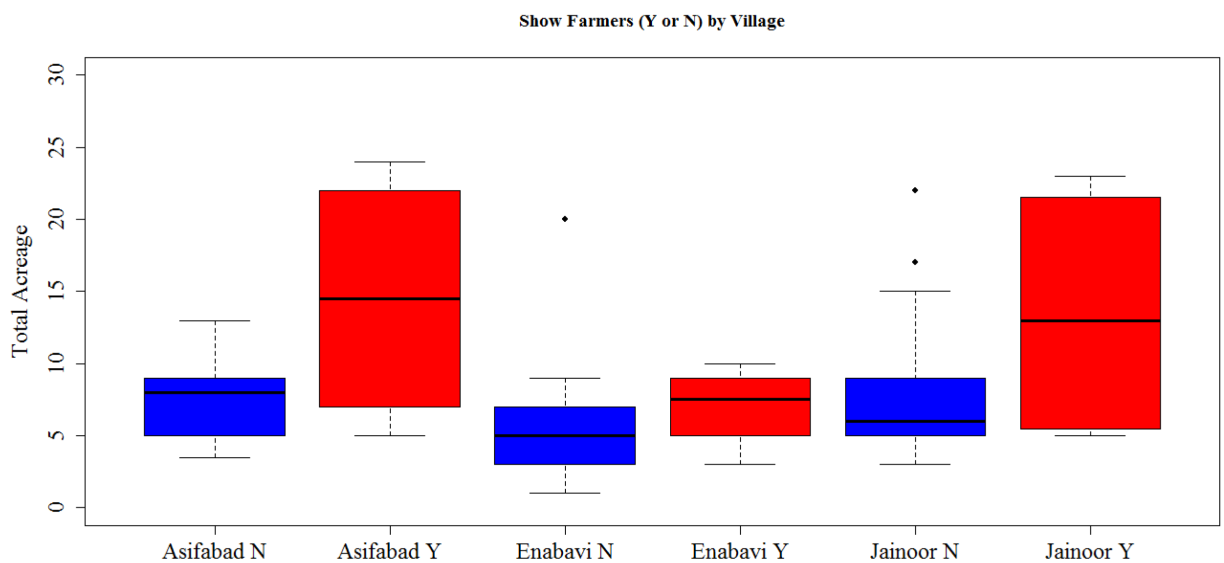
Figure 7.3: Socioeconomic Characteristics of Show Farmers Compared to Other Organic Farmers in their Villages

Addabad (A) n: show farmers = 4, others = 31
Edaggrineelu (E) n: show farmers = 4, others = 29
Japur (J) n: show farmers = 4, others = 31

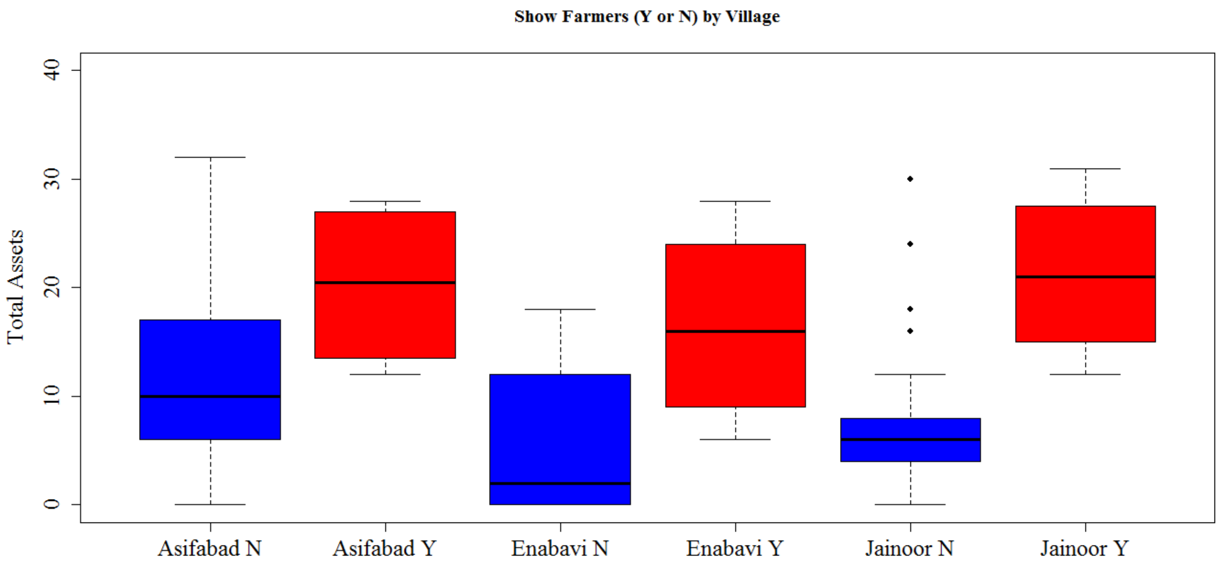
2012 Income as Earned by Show and Other Farmers by Village



2013 Acreage as Held by Show and Other Farmers by Village

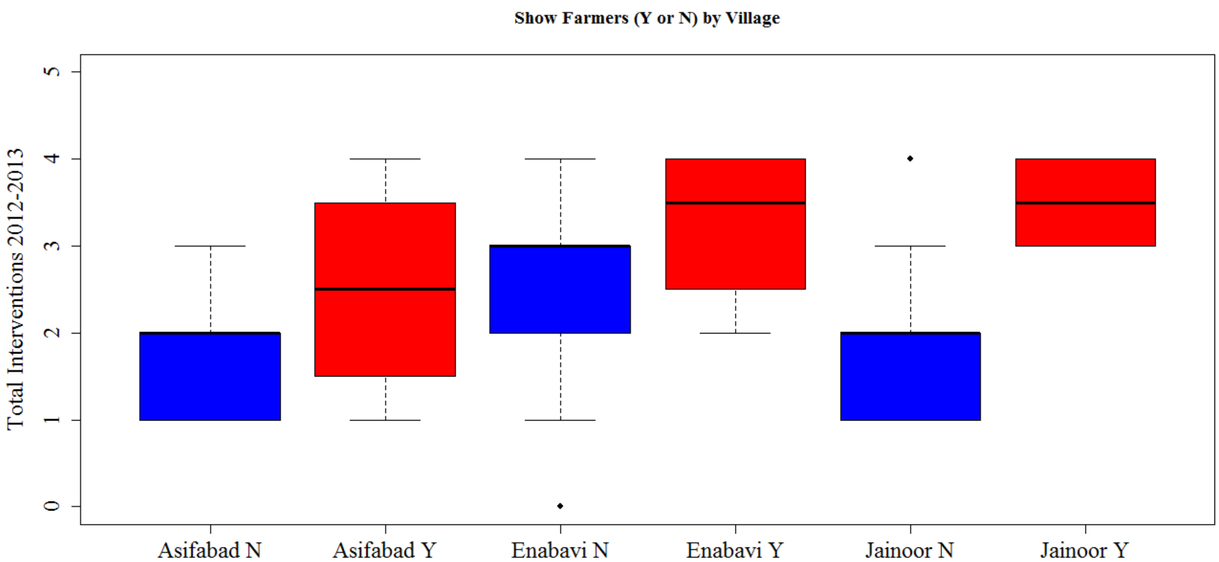


2013 Asset Score for Show and Other Farmers by Village



Asset scores were calculated for organic farmers using the same criteria for the GM cotton farmers discussed in chapter 5

2012-2013 Interventions for Show and Other Farmers by Village



Interventions here refers to the incentives listed above: jobs, seeds, farm equipment, loans, and consultations. Flachs Household Survey 2013.

In some cases, such as comparisons of income and assets in Japur and Addabad, t-tests determined the differences in means between show farmer and other farmer variables to be statistically significant. However, I do not stress the importance of statistics in this case. An analysis derived from a sample of four farmers in each village reflects a small sample size and indicates only that the farmers I identified as being particularly involved in the intervention program tend to have a range of variation that places them in the most advantaged group of farmers with respect to the incentives they take, their holdings, their incomes, and their assets. When show farmers go to meetings and report back to the rest of the village, these other organic farmers miss out on ethnochemistry lessons and instead treat the leaf-based organic sprays like any other commodified input. Similarly, the work of cotton breeding is difficult due to their propensity to self-pollinate and the yield depression in the hybrids that farmers have available. Yet in Edaggrineelu and on a demonstration farm in Japur, show farmers are attempting to breed their own non-GM cotton strains. When new infrastructure is available or when the media wants to feature a farmer, these show farmers step up to reap their social and material rewards.

Show farmer P. Mahesh, a respected large farmer and local organic celebrity in Edaggrineelu, has been trying to make his own cotton seeds for several years: "We are the farmers," he explains, we should not depend on others to get seeds." How's it going, I asked? "Terrible, the seeds are not coming up, it didn't work this year," he answers with a shrug. It is the response of a farmer for whom the stakes of trialing have been removed. These seeds and knowledge about them are, in effect, inconsequential to Mahesh's livelihood. However, he pursues this knowledge for its own sake and to secure his position as a celebrated show farmer. Mahesh explained the process of identifying the best candidates for the second generation by their strong leaves and large fruiting bolls; how he would survey the field for uniformity of height and stem thickness; how he would carefully check his seeds for *beriki*, here referring to a lack of weight or cracking that would suggest that the seeds were infertile; how one must time pollination carefully to spread desirable pollen while preventing unwanted male stamens from dropping their own genetic material; how if you replant seeds too many times in a row the production will drop and (he said with a wizened grin) "they will perform like an old man like me." Designing crop rotations, breeding seeds, and disseminating plant-based pesticides, Mahesh epitomizes a highly skilled farmer. "We can't depend on the companies, because if their seeds fail or they mislead you, you have no recourse and no one to blame but yourself. If you go down that road, you just have to keep buying things until you can force success out of the plant. With your own seeds you can be sure of what you're planting and better predict how it will work." And yet Mahesh's saved seeds account for only 16% of Edaggrineelu cotton seed choices 2012-2013, belonging to the most engaged farmers. While Mahesh continues to develop his saved seed and share that knowledge with those who participate in his minor breeding operation, most of the village is happy to take seeds from the NGO that helps manage organic agriculture and its publicity in Edaggrineelu. "People aren't that interested," he admits with a sigh. "They're happy to take from others but that's not correct." Other organic farmers in the village see have different designs for their time and energy, and have no problem taking the free advice and equipment offered by the NGO program.

Rather than encourage individual farmers to breed seeds, the cooperative that provides seeds and manages cotton trading for Prakruti's organic farmers has built a show farm landscape near their Japur cluster of villages (see chapter eight for a more detailed discussion of this space). Frustrated with the hybrids available to organic farmers, which are in practice the refuge seeds bred by GM companies, Prakruti CEO Ashok Chender procured germplasm from GM breeder

Nuziveedu Seeds, as well as from university breeders. From a potential 42 varieties, he has chosen 12 that may be viable for his farmers and is in the process of growing them on the demonstration farm. The show farmers who manage this space, namely Prakruti employee Ataram Tulanna, a farmer and organic village leader in Japur, look for desirable traits and use their experience with the different varieties to make suggestions for the rest of the farmers in the program. These are the farmers who learn and apply seed breeding and complicated non-chemical field management methods. Rather than use this knowledge in their own fields, they breed for the demonstration farm, showing possibilities to visitors as they attempt to secure a distributable volume of seeds. As in Edaggrineelu, others in the village skip meetings and take seeds or leaf sprays because they are an easy option have no need to generate iterative management knowledge about this technology. For breeders like Tulanna and Mahesh, that knowledge becomes part of regular practice for the show farmers who must demonstrate it to the rest of the village and to visitors. Over the years, these farmers have made minor improvements where necessary, working with the NGOs to adapt seeds, leaf sprays, and fertilizers to local conditions that they can distribute among the less invested majority of villagers. In coordination with organic program directors, these engaged farmers have built agricultural skill.

Rule-Bending and Non-compliance as Strategies for Risk Reduction

At the other end of the still-skilled spectrum are those farmers who cautiously work with organic programs but still make their own environmental or social decisions on other parts of their land. Addabad organic farmer Marskonda Ram has no problem telling me that some of his land is reserved for GM cotton as an insurance against organic failure. As the land is separate from his organic field, he assumes that GM crops and chemical inputs present no problem for his organic certification. Field coordinator Krishna Ram feels differently. "These people are a problem for the certification process," he says. "People try to sell their cotton in with organic cotton and it becomes expensive for us to do any unnecessary testing. The certifiers take 150 of our 2500 farmers randomly and do checks. As such it's better to remove any aberrations from our list." Nervously, he asked for the names of those farmers who had taken GM cotton from outside shops, saying that he needed to check up on them. I agreed as I had asked the farmers earlier if I should keep such action secret and they laughed, saying that Krishna ought to know. In accordance with the letter, if not the spirit, of organic regulation, both are correct as Krishna clarifies the next day: "We certify land, we don't certify the farmer. This way we can register husbands and wives separately to take advantage of government schemes for small farmers." In theory this distinction allows these farmers to maintain separate spaces where they can grow higher-yielding GM cotton with non-organic inputs. When questioned farmers certify that their tools do not come into contact with GM material, although this would be hard to police. In practice, as smallholder farming occurs at the level of the household, these separate spaces allow farmers to trial different management strategies while leaving the door open to opportunities through organic programs.

An hour's bus ride away in the Prakruti-affiliated village of Japur, some farmers devote a minimum of their land to organic agriculture to benefit from free seeds, access to loans, and improvement projects. Their lackluster commitment is justified somewhere between the low yielding organic seeds that villagers remember as being inferior to Bt seeds, and the organic insistence on not using any chemical fertilizers, which "everyone knows" (especially the village's skeptical neighbors) work well. Disgruntled organic farmer Govinder hedges his bets with a separate Bt plot of cotton, voicing the concerns of many that the *digubati raledu* (the yields never come) with the non-Bt seeds. “The only reason we're still part of organic is because Prakruti gives cheap seeds, but the yields are very bad and the profit margins are even worse, thanks to Prakruti's small premium combined with the small yield. Their rules are difficult and problematic because they are banning the solution (chemical fertilizers). If we use the chemicals, they won't take our cotton.” “There is a problem with fertility,” explains field coordinator K. Arjuna, shifting the blame to inefficient government assistance programs. “We're looking to increase liquid fertilizers, increase compost and vermicompost programs, but the government is not working with us. We're giving information, whatever they need, we submit reports, but they are not helping us…the farmers are selling their cattle, but they need to keep them [for fertilizers and plowing].” Farmers report selling their animals and buying or renting tractors to save on farm labor as children leave the farm, to save on the costs of keeping animals, or to buy into the promise of modern machine efficiency offered by quick and fun-to-drive tractors. With sharing schemes and diminishing household labor, farmers have come to perceive tractors to be as economically efficient as cattle in many instances. Thus are the role of show farmers who keep cattle and maintain manure stocks, especially P. Mahesh in Edaggrineelu, especially important in maintaining the image of the idealized rural household in the face of emerging economic strategies for field management.

This is a problem for farmers trying to split their energy between organic and Bt cotton cultivation, like Sitaram. “Now that we have fewer animals,” he explained “the fertility of our land is less. Using the chemicals is better.” Farmers in his particular Japur hamlet, Sompalle, receive the seeds and sprays through more engaged farmers like show farmer Ataram Tulanna of the neighboring Japur hamlet of Sampalle. They plant organic cotton not because they particularly like the program but to maintain access to the rest of the organic program’s benefits.

Unwilling to learn to use organic methods, farmers like Sitaram or Govindrao in Somgdua don't commit fully to organic or non-organic methods, even though they dislike the organic program: "It may be cheaper investment and good for the land but the production is bad now," offers Govindrao. "I took it just to remain friendly with the group. We're always willing to cooperate and it's not like organic is a lot of work. I didn't really have to listen to their instructions - people said do like this and that and they wrote some details down but then they left." "Don't they care that you're doing organic?" I asked. "They don't look closely, they don't come and see our farms so it's no problem," he answered. "They just write and sit and leave. At the demonstration farm they only got one quintal per acre, why would I want to follow that?" He's switching from a low density to a higher density planting system as he saw it have good yield last year in a neighbor's field, a move not encouraged by Prakruti as it decreases the overall agrobiodiversity of the farms and promotes monoculture farming.

It is not clear which space in these Prakruti villages is really the insurance for farmers, as the low yielding organic cotton has few input costs and the GM seed choices that farmers plant follow the same uncertain patterns of shop suggestion or neighbor emulation seen among GM farmers. Local shops have little patience for marginal tribal or low caste farmers buying on credit and the often illiterate farmers develop little knowledge of or interest in the confusing GM brands, identifying them by the pictures on the seed packet cover. Instead it is probably most correct to interpret their fields as a form of cotton diversification: plant the organic cottons that the program has been providing for years that are guaranteed to grow (poorly) and can be sold at a premium, while taking shop recommendations for unknown GM seeds in the hopes of a large yield.

In Edaggrineelu, this loose relationship to the spirit of organic agriculture manifests when farmers simply break rules that do not work for them. PANTA does not certify their farmers, instead relying on the villages' positive press and reputation to entice buyers and writers. A cost-saving endeavor for the farmers and the NGO, this also allows a margin of fraud for frustrated farmers. After telling me there was no Bt cotton in her village, P. Lachmi showed me the cotton she planted this year, genetically modified Dr. Brent from Mahyco. "This year we didn't get much help from PANTA for our cotton seeds. They told us to plant what we could find," she said. Another farmer sheepishly admitted to planting Bt seeds, but asked that I not pass on this information to the NGO. Unlike Edaggrineelu show farmer Mahesh, who carefully makes his own seeds and compares them with those that he gets from the NGO, these farmers sparingly use purchased chemicals and seeds from local shops. "They say not to use chemicals so I don't," shrugs Venkanna, but he's not impressed with the seeds from PANTA. Two years ago he switched from them to buying seeds in nearby Jenagom, going for GM seeds that he does not know by name. He also uses endosulfan, a chemical pesticide, qualifying that he only uses it "a little, and only because a rice boring insect came in such high amounts last spring." Interestingly, he also uses neem sprays mixed by his organic neighbors as well. This may be an example of what Gupta (1998) would term hybrid technology as it awkwardly combines organic and corporate knowledge. However, I believe it is more accurate to view this occasional rule-breaking as a necessary hedging. Like the Sompalle farmers, Venkanna is unwilling to fully commit to the new technology and so has constructed an uneasy compromise that he hopes will allow him to maintain a maximum flexibility and benefit from a chemical alongside a potentially useful NGO connection.

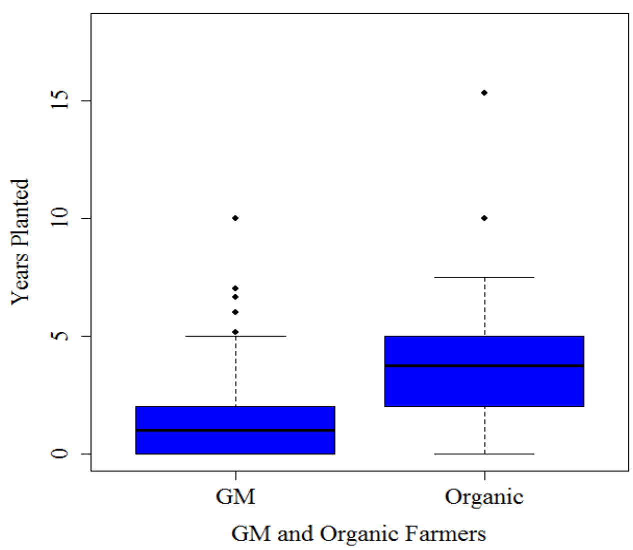
Organic program directors are surely displeased with such farmers who commit halfway. Yet practicing a variety of management strategies and changing them depending on different market, ecological, and institutional incentives allows the farmers to maintain a diverse skillset. Rule-breaking is never good press, but it does allow farmers to experiment with all of their possible options, easing the transition to alternative agriculture. This combination of flexibility and incentives that underwrite the most serious concerns about yield uncertainty help to keep even the most skeptical farmers engaged in the program. The regulation, be it lax or generous depending on one's perspective, allows these skeptical farmers the freedom to conduct long term trials of the different schemes and adapt what works to their own farms.

In this section I have discussed the ways in which organic farmers hedge different kinds of farming to capitalize on organic marketing. The skill fulcrum rests on which farmers are able to balance the risks and rewards of trialing various technologies. Seed choice, a decision that dominates marketing and farmer decision-making among the GM farmers, is much less important among the organic farmers who have that decision made for them. Rather, organic farming skill is a process of learning from the NGOs, keeping what works, realizing what is just for show, and should that fail, maintaining a knowledge base in a backup project.

Learning Under Constraint

In chapter five and chapter six, I linked environmental learning to the ability to recognize and choose available seeds, the time spent planting particular seeds, yield responses, and farmer consensus on seed qualities. Unlike the GM cotton decision process, organic yield response is not an all-consuming variable for farmers. This is not because farmers have a more complicated set of variables to factor or because they are more concerned with reliability as with rice seeds, but because the production costs of low yields with organic agriculture are underwritten by the program. Thus yield is less important to the ultimate calculus of which seed farmers choose to plant. Besides, on these organic farms, cotton seed choice is particularly constrained. 2013-14, two seed varieties, non-Bt Mallika and non-Bt Bunny accounted for 123 out of 175 (70.3%) cotton seeds planted by 84 organic farmers. Given this severely reduced market choice, it is not surprising that these two seeds were each planted for about three years, double the averages seen on GM farms. When the organic seeds are removed from this sample to show only the seeds that farmers planted on their non-organic land without the assistance of organic programs, the average time that each farmer spends planting particular seed brands, about 1.2 years, resembles the time allotted by GM farmers. Taken as an average for each farmer, farmers planting one of the two organic seeds in the organic villages had much more experience with those seeds than the Warangal and Matepalle GM farmers following the seed fads (**Figure 7.4, Figure 7.5**).

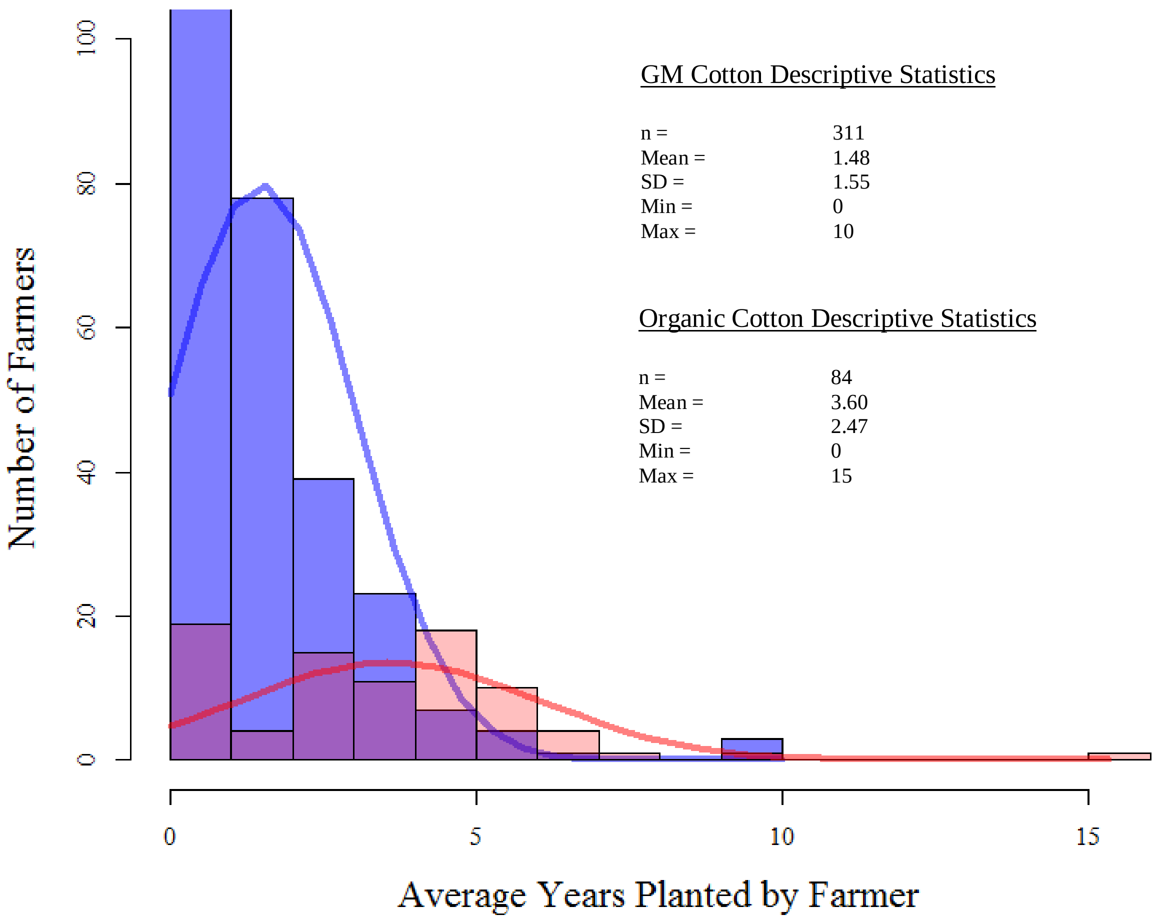
Figure 7.4: Average Farmer Experience with Organic Cotton Seeds Provided by Prakruti or PANTA Compared to Average Year Experience with GM Cotton Seeds 2013-2014



Descriptive Statistics

	GM Farmers	Organic Farmers
n	293	84
Mean	1.34	3.33
SD	1.57	2.01
Minimum	0	0
Maximum	7	10

Figure 7.5: Histogram showing frequency of number of years experience with which GM and Organic cotton farmers planted cotton seeds 2013-14



In this histogram, 0 years would indicate a new seed for the farmer in question. GM planting farmers are indicated in blue while organic planting farmers are indicated in red. The difference in years of experience between organic and GM farmers was significantly significant at p <0.001. Flachs Farmer Survey 2013-2014.

As explained above, a large proportion of farmers received benefits, including at least some seeds directly from the organic program. Like the local vendors who provide most of the rice seed choices to the six GM planting villages in my sample, the organic program is a trusted source of germplasm. It is also a cheaper, and often a required source of germplasm – to be in the program, farmers must plant at least a little organic cotton, even if they also buy cotton seeds from other sources. After removing the eight percent of choices for which farmers did not know the source of their cotton seeds as I did with GM cotton and rice vendors, organic sources accounted for a clear majority, 146 out of 203 (72%) of the cotton seeds planted in these three organic villages (**Table 7.2**).

Table 7.2: Seed Vendors accounting for more than 1% of Total Cotton Seed Choices in Organic Villages 2013-2014

Vendor name	Seed choices from Vendor	% of total choices
Organic Cooperative	146	72%
Village Shop	12	6%
JKS Fertilizers	12	6%
Broker	10	5%
PANTA	9	4%
Saved	8	4%
Venkatesh	3	1%

Flachs Farmer Survey 2013-2014.

Given the fewer choices, more consolidated vendors, and the greater time spent with these seeds, I expected Prakruti farmers to know more about their organic cotton seed choices than the farmers planting GM cotton. Choice overload appeared to play a role in the anxiety-driven choices of GM cotton farmers, while didactic organic programs offer no real choices at all. Alternately, because these farmers have little need to trial their seeds and stay abreast of changes while participating in the organic program, they may have very little widespread knowledge about cotton seeds. Using the same consensus questionnaire I used with GM farmers in 2014, I asked the 64 Addabad and Japur farmers planting cotton to identify phenotypic characteristics of their crop (**Table 7.3**)

Table 7.3: 2014 Cotton Knowledge Consensus as a Row Percentage

	Boll Size				Growth Habit				
Seed Name	**Small**	**Medium**	**Large**	**DNK**	**Tall**	**Both**	**Bushy**	**DNK**	**N**
Mallika	8	46	46	0	38	24	0	38	37
Bunny	20	60	20	0	29	57	0	14	15
Organic[22]	38	25	38	0	25	75	0	0	8

Flachs Farmer Survey 2013-2014.

Although organic farmers planted a handful of other non-organic seeds, no more than two farmers planted any particular seeds, defeating the purpose of a consensus exercise on those seeds. The organic farmers had nowhere near the high levels of consensus found among farmers choosing rice seeds, many of which were above 80% (**Table 6.2**). Like the Bt farmers, organic cotton farmers do not clearly agree on the particular categories of their cotton seeds. Where the conventional farmers' confusion stemmed from a lack of experience with the seeds and a widespread susceptibility to experts or *pedda* farmers, organic cotton farmers plant cotton for nearly as long as the conventional farmers planted rice. I argue that in spite of this experience, organic cotton farmers participating in didactic organic development recognize that their program directors control their choices. Farmers do not learn about these important phenotypic traits because this knowledge does not help them make decisions. Sometimes, even when they try to request a particular seed from the programs, that seed will be sold out – why waste time learning about the most important elements of cotton plants when didactic programs remove farmer choice. Far more important is to play the correct part in the development apparatus and secure lines to agricultural and social incentives.

[22] 'Organic' refers to seeds that farmers identified as coming from an organic program source but forgot the particular brand they chose

Conclusion

While organic farming is characterized by education, different kinds of technology, and a mission to improve lives by promoting a more sustainable future, many farmers involved in these programs appear happy to turn over management knowledge to the program directors and to show farmers in their villages. However, there are notable exceptions. Successful show farmers balance didactic and environmental learning while the rest of their village copies their choices using the same social emulation strategies employed by most GM farmers. Alternately, the organic program is given lip service by farmers who grow a small amount of organic cotton not because they think it will provide a good return but because they want to keep open the avenues to program assistance. Farmers exercise the opportunity to trial cotton seeds, but as their choices are limited to two seeds from their certifying program (at least for their certified land holdings) these trials are not particularly useful in helping them make seed choices in the future. Within these choices, they build relatively little knowledge about these seeds and look to their influential neighbors, just like GM cotton farmers.

Yet on both GM and Organic farms there is a disparity between those who drive trends and those who follow them. Interestingly, both agricultural systems find an interruption of knowledge creation because of an overreliance on social learning. Among GM farmers this manifests in the seed fads and herds driven by a response to a seed landscape constrained by the varieties that large farmers choose to plant. Among organic farmers, the interruption of skilling is found in those farmers who seize upon organic agriculture without developing good connections with the program directors or establishing themselves as show farmers. Organic farmers' general apathy toward adapting the technology given to them in the form of training sessions or seeds leads them to follow the leader farmers who stay engaged with the program and who do the iterative work of fitting that knowledge to their local needs. The organic farmers maintaining agricultural skill break into two different kinds of farmers: those who drive trends by working closely with NGO programs and experts, and those who keep organic farms as well as GM cotton farms as a way to spread their risk and potential gain as far as possible. Rule breaking is in this sense a way to keep the skilling process alive because it allows farmers to trial many different kinds of seeds and management techniques.

Amidst varyingly successful development initiatives, these programs have managed to keep farmer interest in three ways. First, they capitalize on the social influence of early organic adopters, who help to convince the rest of the village of the program's benefits. Early organic adopters are specifically targeted for their influence in the village. Organic programs encourage them to become show farmers, heavily incentivizing their agriculture, even when these early adopters are among the most socioeconomically advantaged in the village to begin with. Seeing these influential farmers succeed then kicks off the social learning so important among non-organic cotton farmers. Early negotiations with show farmers require some back-and-forth during which show farmers adapt program rules to local conditions. If successful, these adaptations then become standard practice for future interventions. "They sucked my knowledge out with a straw," laughs P. Mahesh. His knowledge and influence helped tailor organic suggestions and infrastructure to local needs. Similarly, Prakruti show farmers Ataram Lakshman and Ataram Tulanna work to keep the villages where they live in line, in exchange for preferential access to seeds, jobs, loans, and influence. These show farmers and their role in local social learning will be explored further in chapter eight.

Second, they incentivize organic production to compensate for the lost opportunity costs of planting a higher-yielding cotton and taking their chances in the open market. Organic cotton farmers in my sample produced much lower yields on average than did the GM cotton farmers. To some degree these lower yields might be expected because organic programs recruit poorer, marginal, low-caste and Tribal farmers. However, organic programs like Prakruti and PANTA step in and provide a safety net wherein organic farmers do not need to chase yields and profit margins like their GM-planting counterparts. Where GM planting farmers lack a widely agreed-upon knowledge base for seed brands due to a combination of choice overload, short-term trials, deskilling, and the undue influence of conformist bias, organic farmers receive loans, inputs, equipment, and social capital regardless of their seed knowledge. In exchange for coming under the socioeconomic safety net, they relinquish a material incentive to develop nuanced knowledge about their cotton seeds.

Third, these programs allow for a degree of flexibility in certification requirements that can manifest as fraud or rule-bending. In some instances, farmers are probably taking advantage of lax collection and oversight rules to keep these incentives coming. In others, such as in famers' considerable stores of heirloom vegetables, sorghum, wheat, and rice, the organic program does not monitor or disrupt agricultural decisions. In Prakruti-affiliated villages 2013-2014, 134 out of 157 (85%) of rice or sorghum choices came from saved seed. Further, 130 (83%) of those choices represented heirloom *desi* seeds specially adapted to the area and saved for an average of 10 years. This diversity was evident in vegetable, rice, and sorghum fields, which stood out to this American researcher used to hybrid corn fields for their non-uniformity. As with rice, farmers purposively investigated heirloom crops to find the best tasting, most environmentally resilient, and highest yielding varieties.

An organic farmer poses with genetically diverse sorghum in his field near Addabad.

By asking farmers to maintain subsistence plots and encouraging them to devote land to sorghum and providing free vegetable seeds, Prakruti encourages organic farmers to cast a wide and biodiverse net in their agriculture.

More so than Prakruti villages, Edaggrineelu has emerged as a model for organic agriculture. Among NGO promoters, journalists, and government representatives, its potential as a model village is clear and tantalizing. Such proponents are rewarded with viewers and donors for celebrating Edaggrineelu. But why academics should come to portray Edaggrineelu as organic agriculture generally rather than a particular network of actors is less clear. With titles lauding “the road ahead” (Raghupati and Prasad 2009) and invoking Gandhi (Quartz 2010), academics threaten to take Edaggrineelu out of context, away from the networks of capital and media that sustain them. In doing so, such studies provide, ironically, a poor explanation toward future development. The didactic education program that made this village famous is just as important to their success as the hard work and innovative methods.

Reports stressing Edaggrineelu's potential but downplaying the interaction between farmers and NGOs ignore the most important reason for its success. After acknowledging that Edaggrineelu is supported by numerous NGOs reducing cultivation risk, one study compared Edaggrineelu cultivation "vulnerability" to two other villages as though all three grew cotton under the same socioeconomic conditions (Desmond 2013). While claiming to show an analysis of differential material risks associated with three agronomic conditions, the study ignored the political ecology of aligning with an NGO. Another study, which interviewed 36 farmers in ten villages affiliated with a highly political NGO celebrated the agroecological benefits of *in situ* conservation for both poor farmers and for biodiversity (Bradburn 2014). While acknowledging that contacting exclusively farmers associated with a conservation-based NGO may have influenced responses, the study concludes "that a large section of agrarian society in the Medak district is conserving many diverse landrace crops on their farms that hold important, and potentially important genetic resources" (Bradburn 2014:79). Didactic organic and conservation are made to seem as if they are mere technologies rather than elements of a complicated agricultural and social system.

This misses the point that I have highlighted in this chapter: organic and conservation initiatives are successful because farmers learn to take advantage of program rewards, because farmer emulate particularly successful show farmers in their village, and because the programs provide enough flexibility to allow farmers to maintain a diverse agricultural skillset. Like GM trials conducted under unrealistic field conditions (Qaim 2003), such studies (Bradburn 2014; Desmond 2013; Forster et al. 2013; Quartz 2010) disconnect agricultural methods from the people and institutions that make them work. When summarized by scholars from other disciplines (Rieple and Singh 2010 e.g.), organic agriculture appears as a superior agricultural technology decoupled from the social politics of development programs. This would be especially ironic for farmers affiliated with Prakruti, where the social and economic benefits of participation in the organic programs encourage farmers to grow a wide variety of subsistence and market crops. Naturalizing their success as the success of organic methods rather than organic institutions would ignore the reason for their success.

This chapter has discussed the ways in which farmers participating in didactic organic production schemes trade farm management decisions for social and material incentives. However, as I have emphasized, farmers working with organic projects often take other steps, ranging from rule-breaking to separately certified plots to diversify the risk of fully converting to organic agriculture. The following chapter discusses the way in which certain farmers take advantage of institutional attention and turn it to their advantage to reap extra benefits, illustrated best by the Srigonda cooperative, the personal success of P. Mahesh in Edaggrineelu, Ataram Lakshman and Ataram Tulanna, the organic Patels in Addabad, and the farmers most heavily involved with Desi production and the MATCH NGO in Maharastra. Their position is then reinforced by media attention and the material benefits of equipment, seeds, loans, access to government money, etc. When pressed, such farmers are not typical of the village as a whole and may not even be entirely convinced of the methods themselves, but rather convinced of the benefits. This can be contrasted to the inter-village competition between farmers seeking social prestige through good farming defined by profits, high yields, profit margins and autonomy, and modernity. I draw on several different models of show farmers to make this point, showing that there are a diversity of ways in which farmers are driven by the need to perform, even at the expense of managing their farms. I also draw on interviews with Monsanto representatives, university extension officers, organic program officers, and E-Digu scientists.

Chapter 8: Show farmers

The border that separates the twin cities of Secunderabad and Hyderabad is arbitrary as the two cities have long since merged into one sprawling unit. The Tarnaka enclave in historically British-administrated Secunderabad is home to many of Telangana's most active environmental NGOs, while its proximity to Hyderabad's Osmania University brings together intellectuals and non-profit activists. The parent organizations for the organic farmers in this study, SUS and Prakruti Organic, are both headquartered in this enclave, in fact separated by just a few buildings. SUS's first floor houses a farm-to-fork organic grocery store that buys rice, vegetables, and other produce from Hyderabad's rural periphery. Through these organizations India's growing middle class can support environmentally minded production from their homes in urban centers.

SUS headquarters, and to a lesser extent, Prakruti headquarters, are spaces that allow visitors to see and feel organic agriculture. SUS's first floor grocery sets an agrarian tone for the office. Upstairs, visitors are greeted with art woven from rice made in participating villages while awards for SUS's service and production clutter the walls. A final flight of stairs leads to a board room that houses a long table and a glass cabinet full of jars holding organic seeds. Visitors not only see the fruits of SUS's collaborations, they can see a symbolic seed bank that shows how committed SUS is to conserving Indian agricultural heritage. Prakruti's boardroom also features a small seed bank, although the Prakruti offices devote more wall space to press clippings, Prakruti pamphlets, and posters. SUS, which coordinates numerous smaller programs, shows the potential of alternative agriculture. Prakruti, which works to sell its particular model to donors or distributors, showcases photos of their farmers and successful campaigns.

Although most of my work involved directly speaking with farmers, I had met Prakruti Organic's staff in previous field visits and returned to Secunderabad in May 2014 to speak with the higher level staff. My interview schedule coincided with a visit from Bindu Gugothal, a mid-level executive of Indian origin now living in London and working for the Fairtrade Foundation in the UK. At a lunch before we were scheduled to leave for a farmer meeting, Gugothal explained the way that Fairtrade connected farmers with consumers:

> How much you want to ignore that it's about money, it is still about that. So in a way we go over there try to create markets for [the farmers]. So to the extent that there's a market, there is no assurance, even if it's organic – forget about Fairtrade. Because the difference between Fairtrade and organic is, the way I look at it as a consumer, if I want to buy organic it's for my benefit also because it's going to touch my skin, blah, blah, blah. Like for food I try to buy organic food as much as possible of course, but Fairtrade has got no value for the consumer as such. It's still the same product. So it's the same banana or it's the same shirt, but if you tell people that this is the impact it has, which is minimal in a way what they have to pay. Which is like five pence for one tee-shirt which might be extra, but for the farmer it is quite a bit. So we sit there and we create markets and at the same time we campaign about it so that people are aware what Fairtrade does and what its impact is.

To find stories that encourage people to pay extra for a product that does not give them any extra benefit, Gugothal spent three days touring Prakruti farms for experiences to take back to Fairtrade. As she says above, Gugothal, who holds a master's degree in development studies, knows that these narratives are carefully crafted to elicit a response from consumers. She herself is involved in the crafting and views it as a necessary part of what Fairtrade does. She is not alone.

Monsanto India's website celebrates Pradeep Chivane and Daulat Raghoji Ghatod, small farmers who used GM seeds to save money for their daughters' marriages and provide for their families (Monsanto Company 2012); NGOs recruit charismatic villagers to stand in front of news cameras to extoll program benefits (10TV Telugu News 2013; Prabu 2013); seed and pesticide companies choose farmers living near roads for advertising campaigns, hoping that their signage will sway other farmers; whole demonstration farms are raised to show visitors the potential, if not the reality, of agricultural technology. Who are these people? And why do the same farmers keep appearing in these narratives? Inundated with monthly foreign visitors who want to see the effects of their consumption or investment, certain farmers have risen to prominence. Tour after tour, foreign visitors always seem to stop at their houses, or see the demonstration fields that they manage. These farmers take advantage of attention built into the intervention programs and turn it to their advantage to reap extra benefits. These can include farm equipment, extra assistance, and the intangible reward of being made into a local celebrity.

In this chapter I discuss what Stone (2014) calls the show farmer: farmers who reliably perform for visiting funders, scientists, media, NGOs, corporations, and other interested parties to demonstrate the viability of agricultural technologies. Stone refers specifically not to a category of people but to a role played by farmers. I am expanding that definition here to refer not just to the contingent role of performing agriculture for audiences but to people who learn to succeed in a feedback loop whereby particular farmers gain social and material recognition, enter into closer relationships with their audiences, and gain further rewards as a result. When pressed, such farmers are not typical of the village as a whole and may not even be entirely convinced of the methods themselves so much as convinced of the benefits of working with NGOs. However, the shows that show farmers perform often allow them to cultivate a local celebrity in addition to their material gains. This can be contrasted to the intravillage competition between farmers seeking social prestige through good farming defined by profits, high yields, profit margins and autonomy, and modernity. I draw on several different models of show farmers to make this point, arguing that farmers are driven by the incentives of performance in a diversity of ways, even at the expense of managing their farms. I also draw on interviews with Monsanto representatives, university extension officers, organic program officers, and E-Digu scientists. I will begin by placing the show farmer within theories of agriculture and performance.

Theorizing the Show Farmer

As cultural anthropology shifted toward the study of practice (Ortner 1984), what people do in response to structures or institutions around them, a number of theorists have viewed agriculture as a kind of a performance. Looking to the ways in which small farmers create a series of adaptive, improvisatory strategies, Paul Richards (Richards 1989; 1993) likened agriculture to a musical performance: like improvising musicians, farmers draw on a collection of agroecological knowledge that forms a repertory system when making agricultural management decisions. Richards calls this system of knowledge and practice a set of "improvisational capacities" (Richards 1993:62), reasoning that farmers must call upon a repertoire of experience and resources when managing the environmental, social, and economic variables of the farm. Studies focusing on agroecological resilience similarly point to the necessity of knowing how to manage agricultural diversity (Brookfield 2001) in long-term smallholder farming (Alcorn and Toledo 2000; Sumberg and Okali 1997; Wilken 1987; Leslie and McCabe 2013).

Seminal theorists on the production and improvisation of agroecological knowledge point to the disasters that occurred when farmers abandoned these repertoires in favor of poorly executed development projects that valued gross domestic production over long term household security, or sought to replace farming systems with more legible, taxable alternatives: Green

Revolution rice agriculture was a poor alternative to more efficient temple-based irrigation systems in Bali (Lansing 1991; Lansing 2006); development policies in West Africa disrupted household labor and cropping patterns, leading farmers to lose their land to capital-intensive farms (Netting 1993; Richards 1985); resettled O'odham farmers in the American Southwest created more biodiverse conditions on their new farms than those found in the park from which they were removed, a park ironically created to restore natural biodiversity (Nabhan et al. 1983). These examples collectively point to the danger of relying on didactic, proscribed agriculture to produce sustainable, resilient agroecological systems. These interventions have a tendency to disrupt the pathways by which farmers create knowledge and adapt it to their particular circumstances, especially when they are coupled with the production demands, including quality and capital demands, of a state, NGO, or corporation. If farmers are the performers, these demanding observers compose an audience watching to see how farmers perform their roles as environmental managers and entrepreneurs. Building off of Richards' agronomic metaphor I would like to highlight this *social* aspect of farmer performance as a tool in determining their agricultural success. Social performance becomes especially important when we consider didactic and institutionalized agricultural development programs like IPM or organic.

The interaction between variability, performance, and knowledge is a major theme in this dissertation. Show farmers have been able to leverage the rewards of fame and fortune offered by didactic interventions. While early adopters of new technology generally tend to be more cosmopolitan and to have greater resources available that facilitate their experimentation with unproven methods (Rogers 2003; Stone and Flachs 2014), the show farmers layer an additional level of social performance on top of the qualities that led them to try new things in the first place. Show farmers may be differentiated from other early adopters in that their charisma and success helps them to cultivate a kind of celebrity that they perform in daily life, one featured in news reports or informational pamphlets.

Following Richards (1993), I use performance not in the sense of ritual social dramas suggested by Victor Turner (1980; 1970), but to describe a strategic positioning that farmers present to outsiders and to members of their village in line with the goals of the intervention. In return for playing the role of a farmer benefitting tremendously from didactic instruction, these show farmers are rewarded with various forms of capital (Bourdieu 2010): economic rewards including access to loans, urban consumers, farm equipment, or part-time work with the program; social rewards including a network outside of the caste, ethnic, and kin relationships to provide support and resources to participating farmers; and the cultural capital that goes with being recognized as a successful and progressive person, having qualifications like organic certification or innumerable certificates conferred for 'good' production, being celebrated in media and recognized by various outsiders to the village, and being well respected in the village because of this attention.

I would like to distinguish here between four kinds of performances, in which show farms and landscapes give a particular kind of performance in response to a particular set of institutional rewards. These different kinds of show farmers each perform their agriculture to visitors, differing in how they present themselves and who shows up to watch. Closest to Stone's (2014) description of the show farmer as a role that people take up, *opportunistic* show farmers are those farmers who recognize an opportunity to benefit from a new scheme or program. These farmers are the most contingent group, as their willingness to spend time performing for visitors or to follow the instructions of off-farm authorities including input sellers and NGO representatives is most dependent on their current perception of the benefits. These are the farmers who jump at a chance to adopt a new planting strategy and extol its virtues to the media, only to leave the program once the attention or incentives drop away. The directors of E-Digu, an agricultural intervention program that distributed telecommunicated expertise from Hyderabad, were displeased to find that almost all of their participants left the program once asked to pay a nominal fee for that expertise. This, despite farmers' gushing reports to news and scientific investigators. E-Digu had unwittingly relied too heavily on the loyalty of opportunistic show farmers.

Opportunistic show farmers are often first in line to receive the most material benefits from didactic intervention schemes. Out of the thirty-three farming households who live in the tiny hamlet of Edaggrineelu, nineteen reported receiving low interest farm loans or sales help brokered through PANTA; nineteen received farm equipment including pipelines, seed cleaners, compost pits, and plastic drums; at least seventeen farmers received seeds from PANTA or saved seeds given in previous years. Within that, the ceaselessly self-promoting Edaggrineelu farmer P. Mahesh and his family negotiated for thousands of rupees in loans, control four of the village's seven tractors, save seeds and sell them to other Edaggrineelu farmers, and are gatekeepers to the village seed cleaning machine. Of the seventy Prakruti Organic farming households interviewed in the Adilabad district, twenty-nine reported receiving low-interest loans, all received seeds, and each village was given several communal drums and vermicompost pits.

Over time, an opportunistic show farmer may come to enjoy the success and fame that her or she has received by participating with the program. By this point, the show farmer has become so well known as a media personality that he or she to represent the village, the kind of agriculture, or even India itself. P. Mahesh of Edaggrineelu, a familiar face to Hyderabad reporters discussed below, is one such *celebrity* show farmer. Visitors are directed to these celebrity farmers, who spend a good deal of time with them and seem to really enjoy it. Like all show farmers, their enthusiasm continues to be subsidized by the development initiative in question. But celebrity show farmers take this one step further when they whip out address books or their favorite photographs of visiting dignitaries. Their rewards are as much in social capital as in the more calculated logic of opportunism. Because of this commitment, their loyalty to the program is less contingent on reward than other farmers.

Other show farmers may be thought of as *institutional* because they claim a direct association with shops, programs, companies, or plant science stations. Their job is to farm in the name of the institution, at least while the program is in motion. These farmers, recruited by input companies because their farms lie on the sides of roads or because they are considered locally influential or trustworthy by other farmers, advertise particular technologies or management strategies. Just as the vague authority of the permit system unintentionally gave weight to the fad seeds during a shortage (see Chapter 5), the backing of an institution can make the recommendations or management decisions of these farmers seem more reliable. This authority can be vague and weak, as in the case of input companies that hang seed signs on farmers' fields in the hopes that the seed will grow well and that farmers will remember the name when buying seeds in shops. Or, it can be strong, as in the case of a Srigonda shop owner and farmer whose seed choices and planting decisions carry the social weight of a man widely believed to be trustworthy and who has intimate personal connections with Warangal scientists.

While not farmers themselves, the last kind of performance is that of the s*how landscape.* These are particular spaces set up by intervention programs as demo farms or experimental farms. Often maintained by trustworthy show farmers, these show landscapes present an idealized vision of what agriculture could be, parsing out the messiness or illegibility of daily farm life. Show landscapes can operate to convince visiting buyers of the possibilities of their investment, as in Prakruti's Adilabad-based farms. Alternately, they can show the potential of entire villages as in PANTA affiliated Edaggrineelu hamlet. Because of narratives suggested by the NGOs, farmers, or the reporters and scientists themselves, these spaces can come to represent organic agriculture more broadly, masking the hard work 'backstage' that goes into keeping show farmers happy and keeping this agriculture viable. Of course, these different show farmer types bleed into one another, and particular farmers may perform all of these roles.

Unlike Turner or other symbolic anthropologists who speak of performance as a ritual drama, Ervin Goffman (1956) uses the metaphor of performance to demonstrate that people employ a "front" that allows them to perform the kind of self that they assume their audience wants to see. Such performance is not necessarily fundamental to the person's identity, but can be employed strategically. Thus do show farmers differ from others described in development literature (Agrawal 2005; Escobar 2011; Gupta 1998) who become subjectively transformed or hybridized. The contingency of performance on alternative farms is discussed throughout Chapter nine. In the case of the show farmer, performance centers around their unwavering enthusiasm for the new technology or agricultural program. While many farmers participating in development projects perform a kind of transformative sentiment, show farmers have mastered this art to the point that their performance becomes emblematic of the village or intervention as a whole, even to researchers (Desmond 2013). It is these farmers who accompany reporters on tours of organic farms or speak up in group meetings with NGO or corporate representatives, and it is to these farmers that visitors are directed when they come to learn about life in the village.

Ethnobotanist Gary J. Martin (1995) relays the experience of Stefano Varese, who stepped into a Peruvian village so remote that it was best accessed by plane and was asked if he was an anthropologist. When he answered in the affirmative, the villager said, “Well, I’m an informant” (Martin 1995:97). Just this Peruvian man was happy to play the part of the villager, so too are show farmers happy to perform the role of the typical farmer. All such cases should be viewed skeptically when used to represent a larger movement. In this instance, I am arguing that show farmers are used to create an image of success in Indian agricultural development that does not extend to all participants: the success of show farmers should not be generalized to describe organic or GM farming as a whole. In the next section I discuss the material benefits that show farmers receive in return for their enthusiasm.

The Influence of Audiences on Show Farmers

Show farmers perform a vital role in the agricultural development process by modeling good management behavior so that other farmers can learn from their demonstration and emulate their management choices. However, in doing so, they also play an important role for audiences external to the village. Donors, media, intervention programs like Prakruti and SUS, plant science stations, and agricultural input companies benefit directly from show farmer participation because their performances create deliverable media, including photographs and testimonial stories. These, in turn, fuel investment and donations for future projects while providing evidence that a given intervention, ranging from scientific studies on crop density to NGO watershed improvements, has been successful and worthwhile. Show farmers help such projects along by posing for the photographs, giving interviews to media, giving tours of their farms to foreign investors or visiting people of interest, and by eloquently describing or performing their gratitude for the benefits of the intervention.

Locally, these performances help to generate social and cultural capital in the village. India's numerous aggressive and sensationalist-tilted (Guha 2008) television news and newspapers carry daily reports celebrating successful farmers and sections devoted to management advice. For example, because of their recognition in local newspapers, four of which service Kavrupad daily, farmers in nearby Srigonda have a reputation for honesty and good management. Kavrupad farmers in a 2014 focus group celebrated the knowledge and connectivity of those farmers, especially Naniram, the manager of Srigonda's cooperative pesticide and fertilizer shop. According to the taxonomy above, Rao is an institutional show farmer, associated with input companies and the Warangal plant science station because he manages the cooperative shop. His products and suggestions take on special gravitas. Like many farmers, Kavrupad growers ask shop owners for advice on the newest seeds, pesticides, fertilizers, and pests. Kavrupad farmer Puligujju Ramulu explains during a focus group discussion: "In Srigonda there is a shop that gives good chemicals. As [Naniram] is a farmer he will be supplying good rather than false (*nakkili*) chemicals. He's a good man… If you go to a shop, the owner should say correct things to you. Naniram will say good words." "Because Naniram has been a farmer for many years," chimed in Takkalapelli Chinu, "he knows what is good and bad. He has good knowledge in agriculture and provides the right fertilizers, pesticides, and information to the famers." This is in contrast to Kavrupad's own shop, in which the focus group agreed, "[shopkeeper] Vishnu Rao sells fake products." The Kavrupad farmers distinguish here between trustworthy and dishonest shops, willing to dispense different kinds of knowledge and differentially effective inputs.

Srigonda and its local cooperative gains this reputation in part through years of success and in part because Srigonda farmers are ethnic coastal Andhras and belong to the Kamma caste, having emigrated to this region several decades ago. “See how nicely they’re answering your questions,” prodded one of my research assistants after a particularly friendly interview. “We Telangana people are more rude and less educated.” Andhra areas have historically received better infrastructure and resources from Andhra Pradesh when compared to Telangana areas. Indeed, this disparity was a driving factor in the state’s recent bifurcation. Additionally, they were quick to work with farmer field schools in the early 2000s and have developed a working relationship with the public research station through cotton specialist Dr. Umesh Reddy, who has cultivated a special relationship with Naniram. In addition to the normal social emulation where farmers copy their neighbors’ seed choices (Stone 2007; Stone, Flachs, and Diepenbrock 2014), Kavrupad or Ralledapalle area farmers would often add that the seed had performed for the Srigonda farmers, who really knew about farming. “Everyone is planting the Jadoo seed,” reasoned one Ralledapalle farmer, “but more importantly last year in Srigonda everyone planted it and got twelve quintals per acre.” These yields are reported in the newspapers for all of the neighboring villages to jealously read. As an institutional show farmer, Rao also serves as a hub of expert information, a rising tide that raises all boats in Srigonda. For neighboring villages, Srigonda’s success becomes Naniram’s success. This grain of trust in an anarchic GM cotton market may explain why he sold half (152 out of 310) of Srigonda’s cotton seeds 2012-2014. Rao uses this success to promote his own shop and works with ANGRAU scientists and corporate dealers to stay informed and abreast of new agricultural information.

Institutional show farmers like Naniram use new methods or inputs and broadcast this newness by hanging seed banners. The dirt roads that lead to Prakruti organic villages or to

Edaggrineelu similarly bombard visitors with signs celebrating organic methods and thanking funders. These murals are a large and visible way of advertising organic and conventional products (including membership in the program). They also provide a convenient backdrop against which donors and reporters can take photographs. Here, the audience is more diverse. Signs thanking European donors may have little relevance to visiting farmers curious about a new agricultural method, but are seized on by reporters or visiting donors as a sign of international success. While these farms can and do serve institutional purposes, they are also home to the celebrity, opportunism, and show landscape versions of show farm farmer performances. On my first day in Edaggrineelu, I happened to visit the village at the same time as a crew from 10TV Telugu News was filming (10TV Telugu News 2013). Practiced farmers, who appear time and again in news, NGO literature, and in academic papers, stepped forward alongside representatives from PANTA to show off their fields and demonstrate good farming methods. P. Srinu, an experienced show farmer happy to show off his system of rice intensification (SRI) field, spent the time between takes joking with the cameramen and suggesting particular shots. All this attention has rankled nearby villages, whose teenagers accosted me, teasing, "everyone always goes to Edaggrineelu – isn't anyone ever going to talk to us?" Scheme affiliated farmers in Maharastra proudly showed me their state commendations, earned by participating in various field school programs while Prakruti, PANTA, MARI, and MATCH offices all boast walls devoted to their local success stories. Several farmers in Edaggrineelu have had the opportunity to travel abroad because of their organic growing, even leading Edaggrineelu farmer Anjamma to complain, "we help [PANTA] by talking with people like you and going to Delhi to talk, it's taking up a lot of our time!" Within the villages, farmers that I met for the first time tended to defer, telling me that they did not know enough about the program when compared with the celebrity show farmers. “You don’t want to talk to me,” said one Edaggrineelu farmer, waving me away. “You want to talk to [local celebrity show farmer] Mahesh, he knows everything.”

Celebrity show farmers often leverage the time and energy they spend with visitors to request more equipment or responsibility within their respective programs. Prakruti affiliated show farmer Ataram Lakshman, also his village’s *sarpanch*, or village head, was tasked with distributing free plastic drums and organic spray kits to other villages. More impressively celebrity show farmer Ataram Tulanna (no relation) not only draws a salary from Prakruti, he has been given loans for a small poultry farm, perennial tree crops, and signage to ensure that the other villagers know exactly what he is planting. Both farmers sell cotton and food crops through Prakruti for a premium, and have been working to convince their neighbors and family members to join the program. When meeting with me or other visitors, these men were celebrity show farmers, walking me through technical details of their farming and telling me about recent visits by news crews. When meeting with organic program representatives, they made sure to mention their problems and how long they had been waiting for new materials. When managing Prakruti’s show farm landscape Tulanna shrugged his shoulders at the extra work he was asked to put in to ensure that the farm would be ready for visitors later in the week. It was his job to plant flowers that day, so plant flowers he would.

In Srigonda, two families’ close connection with Naniram’s cooperative store and the Warangal research station led them to be selected for cost-saving agriculture schemes including drip irrigation systems, bird perches, subsidized seeds, and a rice sorting machine that cleans grains and filters away dust that can bring down the rice prices in the open market. Given materials but not urged to perform for visitors so much as simply try to do their best, these farmers were asked to become institutional show farmers. If positive, their experiences with this technology will help research scientists claim that the station is helping farmers and increasing yields. If negative, they will be able to report that the schemes have no benefits for farmers, but the farmers themselves will not have to shoulder any additional risks. This was a mix of opportunism and institutional influence. As with all the show farmers, their agricultural success is tied less to the actual success of the farm than to the reliability of a pipeline for fame, farm equipment, and risk-free production.

In the next section I discuss the experiences of show farmers in four different villages. These cases will clarify the ways in which the demands of different audiences, incentives, and the personalities of farmers intersect to create different kinds of show farmers. In each case, these farmers have also benefitted by becoming local celebrities and working with the development programs to gain different resources.

The Intersection of Audience, Incentive, and Personality in Show Farming

In this section I present two farmers affiliated with Prakruti organic, a GM cotton planting farmer working with the ANGRAU research station in Warangal, a farmer planting non-GM indigenous *Gossypium arboreum* in Maharastra working with MATCH, and a farmer associated with PANTA in Edaggrineelu. Just as the experience of GM and organic farmers was seen to be highly variable depending on the context of the village, show farmers themselves take a variety of forms as they cultivate the show farmer persona. Some show farmers appear to be simply playing a role in order to continue the boons given to them by agricultural programs, but others adopt the show more fully and consistently, building physical infrastructure and local fame. I will distinguish here between opportunistic show farmers, who take advantage of the infrastructure or social capital opportunities offered by intervention programs, and celebrity show farmers, whose advocacy and performance leads them to be more invested in the programs and to cultivate the show persona professionally. I will begin with the opportunistic show farmers.

Many show farmers are selected or rise to the occasion because they share features of early adopters (Rogers 2003): they are more successful farmers, more interested in trying new technology, travel to seek out new information, or have connections to agricultural institutions as in the case of Naniram. In the previous chapter I showed that organic show farmers are particularly well-advantaged relative to others in their villages (**Figure 7.4**), and this manifests in their daily lives as organic gatekeepers and recipients of various forms of social and material rewards.

Ataram Lakshman is the *sarpanch*, or local political leader of Mopalle, a tribal hamlet that transitioned to organic agriculture in 2007. Lakshman was not the first person in the village to transition to organic agriculture, but he has quickly risen to the fore of their efforts. In 2012 Prakruti representatives asked Lakshman to show off his farm when we visited. With an Rs 18,000 ($300) investment, Lakshman was on track to net more than $2000, a wide profit margin for the area. He was especially proud of his intercropping which attracted insect pests to trap plants where he could spray them with homemade organic pesticides. To disseminate information and keep the lines of communication open between farmers and the project, the organic farmers involved with Prakruti and PANTA develop village councils with presidents and secretaries. This village-level political organization mirrors the Gandhian democracy (Quartz 2010) inscribed through the *sarpanch* system: directly elected officials representing the village at regional meetings where they meet with representatives from other villages and bring back new instructions from the program directors. In 2013, Lakshman agreed to serve as president of the Mopalle organic society, leading him to meet with those representatives who wanted to see organic agriculture in action. In 2014, for instance, Prakruti suggested that Mopalle farmers plant johnsongrass (*Sorghum halpense)* and mix nitrogen-fixing pulses with the cotton to aid soil fertility, which Lakshman was obliged to demonstrate for other farmers. He planted johnsongrass in half an acre as a test plot, a small sacrifice on his ten acres. “The program seems to continue to have benefits,” he muses. “Since 2008 it has paid Rs 3000 per year to the school teacher out of the premiums, and that's good. Besides, if we take seeds from outside shops they'll be much more expensive.” Lakshman’s authority as *sarpanch* and as a large landowner with fields close to the village center made him an ideal candidate to test organic methods and oversee other farmers. While not the first adopter or most adamant champion, he saw an opportunity to benefit from subsidized seeds and has since become a focal point for organic success in the village.

IPM proponents similarly tried to convince farmers to apply new management tools in Srigonda. Rather than work through show farmers, the intervention program was built around a farmer field school. Participants reported being generally enthusiastic (Mancini, Van Bruggen, and Jiggins 2007) and adopted IPM methods for a time. However, after a year or two, “it was hard to farm that way,” explained participant Venkateshwarla. “We followed those methods for about two years, but after that we stopped.” The methods were effective, but the introduction of Bt cotton seeds obviated their need for IPM methods. Furthermore, chemical pesticides worked much better against the sucking pests than homemade organic pesticides alone, and the manure composting smelled terrible. Why do all the work of IPM when Bt seeds and herbicides could accomplish the same goals with much less effort? “*Gautham gauthaha*,” shrugged

Venkateshwarla, a Sanskrit aphorism meaning ‘it’s in the past now.’ Additionally, the IPM team never checked back with the villagers, leading farmers to make their own environmental or social learning discussions with pesticides, fertilizers, and GM cottonseeds. However, several years later, Srigonda farmers again began working with extension services. This time the intervention was mediated through a cooperative agriculture supply store rather than an outside group, meaning that the program would feature a more permanent investment in the community. SV Rao describes himself as open to new ideas and has worked closely with Umesh, a scientist at the Warangal agricultural research center, offering himself up as a test case for the extension service’s management advice. Like Lakshman, SV Rao typifies the opportunistic show farmer: cosmopolitan, comparatively wealthy, and willing to try low-risk new methods on a small scale.

With the introduction of Bt seeds Rao experimented with denser planting, observing that the Bt plants were larger and had fewer insects. He tried closer planting the following year in consultation with the research station scientists, observing that he planted double the seeds and saw a small reduction in flowers that was compensated by a large boost in production due to the sheer increase in planting numbers. Like other GM farmers in Srigonda, he has stopped planting non-Bt refuges, but he has replaced them with johnsongrass as per Rao’s suggestion. Pest insects use the johnsongrass as a refuge in place of non-Bt cotton, he explained, while the grass serves the dual purpose of attracting predator birds and feeding cattle at the end of the season. Through Umesh Reddy, SV Rao has received cheap consultation, bird perches, and pheromone traps, all of which he demonstrates to visitors. “Those other scientists don’t know anything,” he laughs. “They come trying to solve problems, but they don't listen to the farmers and don't know anything, especially when compared to people like him who've been doing this all their lives. First of all, they only ask for information at the shop and secondly, at one time, a person came with a question about roots and the shop owner started talking about the tips of the plant only, ignoring both the problem and the farmer's wish." This attitude is a stark contrast with his respect for Umesh Reddy, who not only shows a greater commitment to the village but takes a few farmers, including SV Rao, out to see seeds on test farms throughout the district. If any plants have fewer than thirty-five flowers, Umesh Reddy deems them unworthy and recommends that the cooperative shop does so as well.

Fifteen hours north by train in the Vidarbha region of Maharastra, home to some of the most productive cotton farming and agrarian distress (Plewis 2014; Gruère and Sengupta 2011; Sengupta, Gruère, and Mehta-Bhatt 2008), the MATCH NGO has been attempting to woo farmers away from GM cotton. "The farmers prefer to ask shops rather than talk to us for help," laments director JV Lamedh. "They don't believe us. It took ten years for them to be able to trust us and follow our advice." Here, where yields are comparatively higher, the land is better suited to cotton agriculture, and farmers are comparatively wealthier than in Addabad or Warangal, few farmers are willing to take a chance on MATCH advice. Thus, not only do interested farmers face social pressure to use the same methods as the rest of the village, they fear in increase in pests as insects flock to their unsprayed fields. As in Addabad, the situation is different with marginal ST farmers working in hilly, marginal land – such farmers are more willing to partner with NGOs for the hope of new and better methods. Yet with a handful of wealthy, lowland farmers willing to accept new management, Lamedh is hopeful. Ultimatley, he accepts that he "can't change people, it's up to them if they should change or not. I can only suggest...somewhere the small candle is giving light in a huge darkness."

A twenty-minute drive from his office in Anjangaon, two such candles assumed show farmer roles by planting Old World *desi* cotton (*Gossypium arboreum* L.). *Desi*, meaning native or distinctly Indian in Hindi and Telugu, is native to India and has not been genetically modified unlike the more common New World *Gossypium hirsutum* L. Bhaskar and his friend Motilal are the only two *desi* farmers in the village, and they get their seeds from MATCH. More specifically, their seeds come directly from a foreign researcher free of cost who encouraged them to try planting some with chemical inputs and some without, and compare the results. *Desi* seed underperformed for Bhaskar, which he blames on a personal failure to follow the NGO's spacing directions. Although they gave management instructions, took soil tests, and provided pest traps, "by my own laziness I got a lower yield because I didn't follow the directions correctly," he apologizes. Bhaskar gained better yields with a cotton that he has more experience managing. Motilal is a smaller farmer at five acres and got a very poor yield from NGO seeds, which did not turn him against *desi* but is making him change seeds. "MATCH gives instructions as farmers can't know everything about everything," he explains. "When Bt came people were saying it was bad for us, bad for soil, bad for cattle, and so we've been looking for ways to test this out through the MATCH programs." This testing, of course, is made much easier by the fact that these farmers are planting experimental seeds only on their poorest land, get the seeds for free, and receive free advice from the NGO when they wish. They also gain respect from their neighbors for being chosen as research participants and gain artifacts of cultural capital including certificates and photographs proving their competence.

Later at the office Lamedh was reading a blog (Stone 2014) on show farmers and voicing his appreciation for this expose. Do you have any show farmers, I asked, innocently? "We don't pay anyone, we don't do any media," answered Lamedh. I pointed to the awards and news clippings featured in a case in his office, and he rolled his eyes. "When I got those awards it was a huge pain and not worth it," he said. "Those people growing desi are rich and have lots of land

and are using the *desi* to get something rather than nothing out of the worst of their land." Here, Lamedh is differentiating between those farmers who are poor enough to be swayed by infrastructure or payments, and the *desi* farmers in his own area, who are not poor enough to be interested in such minor payments. Lamedh's distinction refers to a more specific and insidious class of farmers, those who exist at the behest of intervention groups or who concoct stories to raise funds. Like the gifted fabulists of insecurity described in Erica James'(2010) Haitian aid economy or who misled New York Times writer Nicholas Kristof (Kristof 2009; Marks 2014), such show farmers trick benefactors into believing their stories. However, given the various forms of capital that might act on farmers as they decide how to manage their fields, I disagree that direct payments are the only way to classify show farmers. People trialing new technology given to them by intervention groups often become show farmers because of the NGO's need to evaluate success and the farmers' hopes of keeping resources including expanded social networks or extension services, coming.

While NGOs are often essential in securing government resources, state and federal government agencies will sometimes reach out to farmers directly. Tulannaji, a twenty-eight acre holding former school headmaster, has earned commendations from the Maharashtra department of agriculture for being a 'friend to farmers.' Kharmi was selected as a state show farmer to showcase the *desi* seed AK-7, which yielded 11.5 quintals in one acre – a passable but not impressive harvest for this area. The extension service, through Akola University[23], advised him when to plant, water, spray, and fertilizer, and provided the necessary seeds and inputs. During the cotton growing season, his field became a stop on the extension tour circuit, and he explained his methods to visiting farmers or researchers. Kharmi was allowed to keep the profits from his sales. "I tried to save the seeds for next year but the gin didn't return them so lacking

[23] Akola gives the seed its AK moniker, the seventh in the breeding series.

any option in the shops to get *desi*, I went for [Bt seed] Ajeet 155, which works better anyway." He stopped planting when the government stopped subsidizing his farming, and admits that he considers himself to be more of a hobby farmer anyway because of his successful career as a headmaster. "If they want me to demo again I'd be happy to," he adds.

Lakshman, SV Rao, Bhaskar, and Kharmi represent the opportunistic origins of many show farmers. While they stand out amongst their neighbors as charismatic and interested in working with interventions, their performance is still directly tied to the intervention and its benefits. In different ways, they also represent institutional show farmers, as each farmer participated at some point in a contrived agricultural demonstration project. They were essentially employees of an organization, farming in a particular way to satisfy an agreement with a project designer. Recognizing that social learning is key to Indian agricultural management, especially Bt seed choices, interventions through the government, research station scientists, or organic programs underwrite the costs of production for these farmers hoping that their success or personality will convince other villagers. However, opportunistic or institutional show farmers' own investment in these programs tends to be shorter lived – these are not farmers who necessarily stay with the program over a long term or who work to ingratiate themselves with visitors and program officers. A combination of personal charisma, social capital, and cultural capital makes them ideal performers from the program's perspective because their actions carry more weight in the village. But such farmers do not make special efforts to continue performing in the absence of clearly defined rewards. When the programs end, so too does their devotion to the methods suggested. Such farmers are, in a sense, expensive and risky for the intervention programs. While they can wield a positive influence in the rest of the village, if they fail to do so, the investment in their education or infrastructure represents a sunk cost for the intervention. For programs more interested in one-time field schools or photo opportunities, such show farmers can benefit from a year or two of underwritten agriculture at very low risk and provide the program with the deliverables it requires. For programs intending to enact more long term change, a different kind of show farmer must be cultivated: the celebrity show farmer.

While all show farmers are opportunistic in the sense that they seize the chance to benefit from the program when offered, the celebrity farmer becomes more personally invested in the intervention scheme. Sometimes they come to be directly employed by the program, but the material benefits of enthusiastic participation can result in a positive feedback loop: charistmatic farmers are singled out to demonstrate methods; their success provides them with opportunities to gain more equipment from the program and with a platform to gain publicity or local fame; this extra attention allows them to be increasingly successful farmers as it results in more market options and more subsidized equipment. Ataram Tulanna of Prakruti's project in Japur would better fit the show farmer decried by JV Lamedh of MATCH: he is directly paid by his parent organization, which relies on him to maintain the image of progressive agricultural production.

Tulanna draws a salary for his work in maintaining a demonstration farm near Japur and for helping to keep track of member farmers in his own village. As an employee for Prakruti, he helps cultivate the image that tours and researchers see. When I met him for the second time in 2014 he was in the midst of planting and labeling economically useful palm trees at the Japur show farm. But as a show farmer himself, he is also able to seize upon the best projects offered by Prakruti. He knows all of the eleven households in his own organic-producing village, and is related to most of them. As the second-largest landowner, his decisions carry weight and influence his fellow farmers. His field, which includes an experimental poultry farm subsidized by loans secured through Prakruti, features model cropping patterns and signs for the benefit of visitors. When a contingent of farmers affiliated with a Maharastran NGO travelled to visit his village and see how organic agriculture worked, Tulanna helped to lead the tour, explained how he was using vermicompost and chicken manure, and ensured that a hot meal was waiting. Through Prakruti, he secured fruit trees for his mother, a way of easing her agricultural workload. In addition to guiding visitors through the village, Tulanna's farm serves as a reminder of good practices while his presence in the village discourages unconvinced farmers from breaking the rules.

As his village's organic president, Tulanna relays information and enforces organic rules in the village. "Tulanna tells us how and what to do," explains neighbor Prakash. "By using the outside methods like (chemical fertilizers) DAP and urea and (pesticides) sprays, we end up spending too much. We're using [those organic methods] now on the Bt cotton, which did 1 quintal better, but it's not worth it. Next year we're doing all organic. With that we need only cow dung." Tulanna was additionally charged with distributing seeds to farmers in his area – as a show farmer, he was able to ensure that his village received seeds first and to maintain the correct balance of payments back to Prakruti. Other villages, such as the neighboring Ranaguda, which lacked in-village show farmers and the attention of visitors or the NGO, fell behind on their payments or lax in their self-regulation. These villages now face dismissal from the organic program, a fate that would harm Tulanna's social standing in his own village, his salaried position, and future opportunities for low risk agriculture if he allowed it to happen where he lived.

Naniram of Srigonda similarly seized upon an opportunity and became a local leader as a result of an agricultural development intervention. Naniram managed a local input store and together with help from Warangal plant scientist Umesh Reddy transformed the space into a cooperative charged with selling quality inputs, delivering good advice, and pooling money that could be used for collective equipment such as seed cleaning machines. Like the opportunistic show farmer SV Rao, Naniram initially used his influence to secure loans and equipment for himself and his family, happily participating in development initiatives but not himself leading them. Over time, the success of the cooperative grew, and Naniram has come to be well respected in the region as an honest and admirable business leader. This reputation, combined with his access to research station resources, led him to work with Umesh Reddy to test various IPM methods, chemical combinations, and ultimately non-Bt seeds.

Rao, who experimented with non-Bt seeds on a small scale in 2013, planted a larger crop of non-Bt cotton with the intent of saving the seeds and selling them next year in the shop. "Bt seeds are becoming worthless," he contends. "As for cotton, the owners in Warangal shops claim that farmers don't know company names in cotton like Kaveri, but they know the three brands [of popular Kaveri seeds] Jadoo, Jackpot, and ATM. This is a trick by the company to make it seem like there is a larger selection than there actually is…actually the Bt seed has a germination problem, and dies after the first picking. Non-Bt lasts longer." Knowing that I was interested in people's perceptions of cotton seeds, Naniram held that the yield from all of the different brands was mostly the same, and that the Mahyco company's seeds became popular because they cornered the market on bus advertisements. Because of Rao's connection to university extension services, he has been able to field test non-Bt and give the rest of the village anecdotal advice on its success.

In 2014 he procured seed from the university extension service, who in turn got it through a Tamil University. Without these connections it would be very difficult for a farmer to find these seeds by his own volition. Based on Rao's suggestion, four farmers planted non-Bt cotton in Srigonda up from only Rao himself in 2013, and the rest of the village was watching with interest. Rao, who has a degree of freedom to experiment in agriculture because of his shop income, is humble about his effect on the rest of the cooperative, saying that all farmers "follow only their own opinions." His brother, an engineer who spends half his time in Sweden working for Saab, is more blunt: "we are blindly following my brother."

While Tulanna and Naniram benefit directly from intervention programs and work to perpetuate these, their level of celebrity stops outside the village or their immediate social circles. This is not the case for Edaggrineelu's most emblematic show farmer, who has been featured in international news reports. "Can I ask about P. Mahesh himself," I asked SUS director VG Ramesh.

> Andrew: He's a very charismatic person. He was telling us jokes and walking us around [in Edaggrineelu]
>
> Ramesh: See he's a very knowledgeable person and a good leader who could mobilize the village so we always feel such charismatic leaders are important for influencing communities on a large scale. Most of the people in the village trust us because of Mahesh.

Ramesh argued that the character of Mahesh was key to establishing organic production in the village - he was trusted and well liked, leading others to follow him and allowing this village of seemingly normal, isolated farmers suffering from pest attacks in the heart of the Warangal district, to become famous and capitalize on this unlikely success. Indeed, P. Mahesh can be found in virtually every media piece on the story of organic agriculture in Edaggrineelu village (10TV Telugu News 2013; Venkateshwarlu 2006; Express TV 2014a; Express TV 2014b; Misra 2009). His fame, and the fame of the village are evident not only in news reports but also in academic writing (Desmond 2013; Quartz 2010). While his expertise makes him a fascinating interlocutor, the way in which Mahesh comes to represent the village or the way in which the village is used to represent organic production generally is misleading. This elision is especially troublesome because it hides the show and performative aspects that make these farm spaces work. They are not, in this sense, naturally productive or better, but are sustained by a thick social network of expertise and support. Walking through Edaggrineelu for the first time I was told, “you don’t want to talk with me, go talk with Mahesh. He knows everything.” Even after I explained that I was there to learn from and talk to all the farmers in the village, all roads inevitably led to Mahesh.

Mahesh is the quintessential celebrity show farmer: He is old enough to have given away most of his land, but remains a stalwart and photogenic farmer in his remaining acres; despite earning awards from the central government for farming, he spends his days stacking dung, inspecting his fields, and telling his story; other farmers in the village urge visitors like myself to talk to him and leave them alone. It is Mahesh who appears in countless news and scientific reports. “Write a book about us,” he demanded one morning over tea. He says that he remembers first gradually switching to chemicals before becoming fully “addicted” to them, explaining that he was caught in a kind of trap where he had to borrow money for fertilizers and pesticides if he wanted any yield at all. At the lowest point of desperation in the mid-1990s, when he was adding many chemicals to his land and it seemed as though the red hairy caterpillar (*Amsacta albistriga; bantha purugu* in Telugu) would eat his entire yield, he met a PANTA field director named Linonda. “I told him, I want to go back to the ways of my forefathers, but I’m not sure exactly how to do this and I’m worried about the risk of doing it,” he explained. Through that initial partnership they staved off the caterpillars with light traps, a non-pesticide method, and their success gradually convinced the rest of the village. “For the first eight years we were working so hard that when people came to visit, we had no time to talk with them. But now we have time to talk," he explains, "because everyone needs to know about this." Mahesh has been interviewed by scientists, and appeared in stories about the future of India, spoken with movie stars, and met MLAs and other politicians. Through these meetings, Mahesh told me that the Indian government pays him Rs 3,000 ($50) a month to stay in Edaggrineelu rather than take the myriad offers to live elsewhere. In fact he's been to London, Australia, New Zealand, and North and South America to speak about and see farming. Linonda denied some of this, suggesting that Mahesh may be aggregating the not insignificant fees, prizes, and extra sales that he receives through his extensive travelling. "When the visitors come and buy things," complained his neighbors Anjamma and Ranjajamma, "They only ever talk to Mahesh and his family."

As we became more comfortable, he shifted his narrative slightly to give his own role more importance. When I asked if PANTA used any of his suggestions, he grinned, saying that "they sucked my knowledge out like a straw. They give good advice and help," but "it's mostly all from me." SRI only became popular after Mahesh started using it, even though he was not the first person to do so in the village. Mahesh keeps a book, which I signed, in which he collects business cards and contact information from all the visitors he has met. Just as Mahesh relies on PANTA to support his sense of celebrity and to continue providing good opportunities for his family, PANTA relies on Mahesh's celebrity to help spread new methods and to charm important visitors. E. Srinivas, a neighbor farmer, explained that PANTA brings people to see his SRI fields as his production is especially successful, but conceded that most information flows from Mahesh and PANTA, who hammer out details to the rest of the group.

Mahesh is also useful to the narrative of the pristine organic village in that he uses non-mechanical, non-chemical, and non-industrial methods that no one else in Edaggrineelu uses. He is the only farmer to consistently produce his own seeds, a point rendered irrelevant when PANTA provides free non-Bt seeds to the village. Still, Mahesh argues that "we are the farmers, we should not depend on others to get seeds… If you go down that road, you just have to keep buying things until you can force a good yield. With your own seeds you can be sure of what you're planting and better predict how it will work." Cotton seed breeding is difficult, unnecessary work in a village where PANTA gives the seeds away. What that work accomplishes instead is perpetuating the narrative that farmers, symbolized by Mahesh, eschew the trappings of modernity (Misra 2009). When I ask Mahesh if anyone takes seeds from shops or PANTA he scoffs, "those with no patience." In practice, 58 of the 69 cotton seed choices reported in 2012 and 2013 were not saved.

Having discussed the experiences of different kinds of show farmers, I will move on to show landscapes in the next section. In these demonstration spaces, audiences see the performance not just of a show farmer but of an entire stage. I draw on the experience of tours moving through show farms in Prakruti villages, media crews working in Edaggrineelu, and a cooperative society meeting in the GM seed planting village of Srigonda to argue that show landscapes serve to create the impression that the intervention is having the impact that donors or supporters want to see. Such spaces take time away from fieldwork for the farmers who actually care for them, but are crucial as demonstrations for other farmers interested in adopting their methods and an important part of the show experience for potential investors.

The Demonstration Space

When we arrived at Prakruti's Japur field station on Monday, several of the farmer-employees were hard at work planting trees and vegetable starts. "We have to get ready because people from the World Bank are coming" said Tulanna, an organic farmer who also takes a commission from the program as a field officer. It was the third time I had visited this field, a demonstration and teaching space just outside of the town proper and adjacent to the hilly tribal *thandas* where most ST farmers made their homes. This is one of the places where foreigners are brought when they want to tour a Prakruti facility and meet actual farmers. By Wednesday, the farm was bursting to the seams with plant life and English-language signs detailing each plant's place in the farm ecosystem. "We had to finish in time for the foreigners," explained Tulanna, who had been working alongside a newly hired warden who lives on site part of the year, as well as two additional Prakruti staff members to take plants from local nurseries and farmers. In context with other fields during the late monsoons of July 2014, the demonstration farm looked strangely out of place because of its thriving, full grown crops – the village farms, floundering due to a lack of water, lay empty.

Prakruti manages several demonstration spaces near Addabad and Japur. Managed by local famers for a small fee, these demonstration farms advertise the full range of organic possibilities. Tulanna served in one capacity as a show farmer, but he also helped to manage this full show landscape. These demonstration farms are key stops for corporate tours and fact-finding missions. Throughout the year, Prakruti employees estimate that one or two foreign companies or regulatory representatives per month will come to visit their Telangana operations. To encourage transparency and build a relationship between buyers and growers, Prakruti often schedules tours where visitors can see various farmers and sites to help them feel good and see the product of their work. The show farm landscapes allow visitors, including other farmers, to see high-functioning organic farms without disrupting actual farmwork. In the case of repeat visitors, especially a Japan-based company, Prakruti has facilitated long-term research and has facilitated annual trips to maintain relationships with producers.

These tours emphasize the need to show donors or clients a good time as they learn about every step of their production chain. A full tour in Telangana most often includes a visit to the Hyderabad main office, a trip three hours north to see a cooperative near relatively urban Karimnagar, a visit to the Utnoor office near predominately ST Addabad and Japur, and often a visit to the Rajalakshmi gin to see the very cotton bales that are destined for their shelves. Jim Digger, co-founder of a San Francisco-based organic clothing company visited Telangana three times in 2013 as part of an effort to scale up production of organic socks. Digger mentions that his company's website features the story of the producers, which he has personally collected on trips like these. "We demand transparency. I always go through the whole supply chain", he says. As championed by their online press page, the company's work has been featured in typical green forums like *Treehugger* and *Ecofabulous* as well as favorably reviewed on morning talk shows and fashion magazines, as well as in news outlets like the Wall Street journal and San Francisco Business Times, which link it to a new trend of socially responsible corporations trying to move away from a traditional business model. On one trip in January 2014, Chender joined five Americans, three from the organic company, and two from a larger organization's corporate social responsibility (CSR) wing. Like most companies trading in ethical clothing, part of their buying power, in this case close to $25,000, is directed at social programs including the construction of a science lab in a tribal village. "They're major potential donors and business partners" explained Chender, "so we're doing all this work." In Adilabad, the American visitors all planted mango trees and then visited a school where they had lunch and saw a traditional dance program. Photos and stories from their experiences, which also included a tour of the science lab that their funding helped build, made its way to company blogs and promotional media. Such promotion, as Gugothal notes at the beginning of this chapter, is in many ways *the point* of organic, fair trade cotton. Without the image of progress the cotton loses its added value, the consumer's trust that their purchase is better for the farmer and the earth. The following summer, cruelly deprived of monsoon rains, some of the mango trees had died. Fruit, of course, wasn't the point – the trees had already served their purpose.

Later in that tour we visited a village that welcomed us with a banner, thanking the visiting company representatives by name for their contribution to a poultry farm. Looking at the mud-brick building with hens, food and water troughs, electrical hookups, and a thatched roof, the American donors asked Prakruti area coordinator Arjuna how much the operation cost. Arjuna answered that the operation cost about Rs 45,000 ($750), which satisfied the Americans visitors but left me puzzled. A. Raji, Prakruti's finance manager, traveling with the caravan encouraged me to ask the farmer directly, in Telugu: Rs 15,000 ($250), a much more reasonable price. Why the discrepancy, I asked Raji? You see, he said, "45,000 probably referred to the total amount given for the small poultry project. With 45,000 we have enough to fund three such projects…Still, we must be careful about selling poverty, even though in India it happens everywhere." He laughs and explains that even he took a pay cut to work with Prakruti so that he could feel better about giving back to the community. Such financial alchemy, he argues, is necessary to have a large impact with tangible, deliverable results for donors.

An hour across the valley, Prakruti has helped to build a demonstration plot for visitors seeing Addabad. In January 2014 I joined Prakruti field coordinator Krishna Ram to meet with representatives from a German fair trade organic shoe company. The entourage included the company’s founder, a photojournalist documenting the trip, and an artist-musician who had composed a song about organic awareness.


Photographers stage a photograph with Prakruti cotton producers holding their product.

The previous day they picked cotton and visited fields, but they had come to Addabad to see the full range of organic possibilities demonstrated on the Addabad show farm. The plot itself was impressive: two acres donated by a local farmer, Ragu, who managed it along with his family, selling fruits in the market and earning about Rs 5,000 per month from the orchard alone. The infrastructure and design were themselves donated and built by Prakruti. I arrived earlier than the foreign visitors, in time to see Ragu sweep the concrete walkways, connect a rain cistern that would not be receiving rain for months, and brushing cobwebs out of the vermicompost pits. The farm contains drums holding organic spray-making materials, a biogas demonstration, a fishpond with a hanging gourd terrace, an orchard of biomass trees (*Gliricidia sepium*), fruit and vegetables, vermicompost pits, rain catchment systems, and a small hatchery that will be empty until the after cotton money comes in to finance it. As we waited, Ragu and Krishna told me that the land itself was formerly rocky, erosion-prone, and unproductive, which is why Ragu donated it in the first place. Over several years of soil-building, nitrogen-fixing *fabaceae* plants, especially sunn hemp (*Crotalaria juncea*) and biomass trees, the land has become more productive. When a car appeared in the distance, my own tour stopped short as Ragu's family lined up to greet the more important visitors. Accompanied by English-speaking Prakruti employees, the potential investors gathered pictures, videos, and fruit. "We want to make the story about organic more fun," explained the founder. "We want to show the impacts of the commodity chain and make it seem more real to people, not just something for activists." In practice this involved several staged photographs with their products and a few snippets of Prakruti staff and Ragu's family singing a song about organic production, namely the refrain: "have a good feeling, have a good life." Is this a marketing campaign, I asked? "Not exactly" answered the artist. "It's more of an awareness campaign for organic itself. These [songs and photographs] will go on the respective websites social media platforms for the company but also be promoted on Youtube."

A third Prakruti show farm lies near Patelpalle, near Japur. Still being built, this farm features the same English-language signs as the others, a planting strategy that makes it impractical for agriculture but very useful for demonstrating organic methods to visitors. Patelpalle has the additional advantage of a vocal, female *sarpanch* who heads the well-organized female self-help-group (SHG). Like cooperatives and village societies, self-help-groups (SHGs) are emerging in India as both a useful democratic village-level political force for women and a convenient promotional tool for gender equality oriented NGOs. During one tour with a representative from a World Bank affiliate and a Tamil clothing company, the SHG explained that they earn extra money through a tool rental service, which recycles funds back into their cooperative village pot. While managed by local farmers, the SHG's tools and the idea for the cooperative fund came from Prakruti. In response to a number of leading questions asked in English and translated into Telugu, including ‘how has organic improved your life,’ ‘what does Fairtrade mean to you,’ and ‘why did you switch to organic production,’ the *sarpanch*'s husband noted that organic meant that he made his own fertilizers and used his own resources, while Fairtrade was about women's, tribal's, and childrens' rights. But does this affect your health, asked the visitors? “I want to understand if they really feel it,” Tamil entrepreneur Kehan explained, referring to what she called the ‘heart and soul’ of organic. Finally, her prodding resulted in the right answer: “I switched to organic because I could see that it was bad for the environment,” offered Patelpalle’s *sarpanch*. Finally satisfied, Kehan applauded.

Back in Hyderabad, I asked Prakruti employee Sama about these tours:

> We don’t give any kind of orientation to the farmers. Since 2004 they are getting visitors so all the farmers are versed in the practices and all so of course sometimes there are deviations and all, sometimes they don’t want to do it, sometimes they feel that now this [Prakruti] support is not sufficient. But the thing is on the whole people like the program so actually when visitors come they explain it…If we have [an event like planting mangoes] to encourage the buyers and all, they should feel like they did something good…if they do something there they will also feel, they know that something is happening there. So we generally present the progress also to them. Generally they ask for some progress, what happened with that we want to see. And they come again many times people come again. So even they come again we will, we take them to that place.

Over time the repeated visitation and attention reinforces the roles of the show farmers and the show landscape. These dynamics soon reinforce each other: stages require performers. Demonstration farms in Patelpalle, Addabad, and Japur are geared toward tourism first and functionality second. The farmer managers are permitted to keep or sell what they produce, but the spaces exist to cater to outsiders who are unable to even meet show farmers in their fields. These are idealized farms, devoid of complaining farmers or failed crops. Instead, visiting farmers or investors see a microcosm of potential, groomed for their pleasure. As such they provide the perfect backdrop for photographs and branding media, even in cases like the Japenese company, where a group expresses a commitment well beyond a tour.

Eight hours south in Edaggrineelu, signs greet the visitor to lead the way to the village itself. Edaggrineelu's farmers have not set aside land for a show landscape. Rather, their village is itself the show, especially as filtered through their show farmers. During my first visit to Edaggrineelu I coincidentally arrived on the same with a news team who had come to the village to film a report on organic methods, especially SRI cultivation. Edaggrineelu, as an early pioneer organic village championed by the eminently filmable and interview-able Mahesh, has had an image cultivated around it by PANTA and SUS representatives, news agencies, researchers, and government officials who reference it as a model for the rest of the country. This image rests on the full participation of the village in organic methods, Mahesh's leadership, and a willingness to evangelize their success. VG Ramesh of SUS explains:

> [There are] many kinds of people. See, regularly there are a lot of students who come to study and understand. And a lot of farmers who come. A few entrepreneurs who come to make business out of it, to buy and sell it, a few political party leaders so that they can also replicate it in their own villages. So all kinds of people are coming. But mostly it's the farmers and NGO people and students…When they go through us we see the purpose and then based on that we schedule it in such a way that there'll be somebody there to help them to translate and that kind of thing. Otherwise they'll go and meet any of the farmers in the village. We told farmers: 'don't stop your work and then sit with anyone. So whenever somebody comes, take them to your field or ask them to come to your field and make them understand.' Earlier we also had one more village called Punnukallam, but all of the attention from Punnukallam has shifted to Edaggrineelu. Punnukallam used to get attention like that. In fact people used to come on buses, there used to be two, three buses waiting outside the village in 2004, 2005, 2006, 2007. At that time. Then interest has shifted to Edaggrineelu. Then interest shifts to some other village also. It's a kind of development process.

When the village becomes a performative space the villagers defer to the show farmers. They know what visitors want to hear and have experience working the system of NGOs, media crews, or foreigners to everyone's advantage. When the villagers initially told me that they didn't know anything and that I would get more knowledge from Mahesh, their protestations of ignorance were an attempt to salvage the idea of Edaggrineelu that had brought them local fame and success. Only after speaking with all the farmers did a more immediately pragmatic and complicated narrative emerge, where farmers bought whatever seeds they had access to, sprayed in times of serious problems, or used tractors to plow their fields because it was much easier to do so. This is not to say that many farmers were not using organic methods. Rather, the show landscape of Edaggrineelu serves the image of a model organic village staffed by a model organic show farmer. Not hidden, but not advertised, is that Mahesh is a respected elderly person with sons who have land, and no longer relies on agriculture to make his ends meet.

In Srigonda, the Mahalaxmi cooperative shop served as a space of performance, where show farmers and authorities could network and where farmer patrons could learn from them. As a cooperative, the shop holds an annual meeting of shareholders, run by Reddy and Rao. According to Umesh Reddy, the government has in interest in encouraging these cooperatives as they take some of the burden off of farmers by providing better quality materials at better costs than other shops. Such cooperatives also give the government efficient access to a rural voting bloc, which has been key to the last several state elections. The meeting itself followed the standard rural NGO meeting format: several experts, including the local *sarpanch*, two large farmers, two plant scientists, and Rao himself gave speeches on the financial status of the cooperative and on their visions for future directions; questions were invited from the audience; and the meeting adjourned for a large sponsored lunch. The cooperative board, despite Reddy's repeated requests for audience members to come forward and speak, dominated the conversation: "We need to trust the cooperative," they said. "The cooperative gives us good prices and advice," echoed others, highlighting its expert connections, "it has both businessmen and scientists there to help the farmers," and "it is better than the shops." Near the end of the meeting, one ST farmer stood to raise a complaint. The share system based on investment, gives more buying power and return to the higher caste members who live in Srigonda proper rather than in tribal *thandas*. Another objected that shop needed more storage space and was told that the board was working on it.

Caste, always an issue in rural politics, was sidestepped by the panel. "Stop identifying your caste," complained an exasperated Naniram. "We're all farmers, there's no need to say I'm an ST." This brushes aside the differences of wealth and investment capability between the very different kinds of farmers who leave near Srigonda and in its marginal *thandas*. As to the question of influence, Rao reminded the assembled farmers that the cooperative ran on "one farmer one vote, so the large farmers do not hold greater power." Despite these protestations, the composition of the cooperative board indicated who was talking and who was being talked too. Umesh Reddy concluded by stressing that the cooperative was special and likely to succeed because it combined the power of science, embodied by him, and the power of business, embodied by Naniram.

Both show farmers and show farms help to perpetuate the perception that interventions are transforming agriculture on the ground by creating the image of success for visitors and interested interlocutors. In the case of the cooperative, part of the performance is targeted at the farmers themselves, asking them to buy into the egalitarian idea of the cooperative because of the authority and knowledge of its organizers, even when it seems to be un-egalitarian in practice. Intervention programs from corporations, government agencies, and NGOs rely on these people and places both to prove to outsiders that their methods are working and to convince other farmers that they should follow suit. The final section of this chapter considers this performance in the context of social, environmental, and didactic learning.

Didactic Learning and the Perks of Show Farming

"Every brand wants a story." In the conference room of his Secunderabad office, Chender, executive director of Prakruti Organic, is explaining how he balances the demands of farmers, regulators, retailers, consumers, and his own socio-environmental agenda through Prakruti's production chain. Bindu Gugothal of Fairtrade UK and myself listened as CEO Ashok Chender tells us how much time, money, and logistical difficulty he faces ensuring that brands see that their money is well spent and can create a media package that can help to sell the product. Chender himself is most interested in encouraging better practices and a more sustainable agriculture: "We need to encourage resilience...and in smallholder farming resilience means subsistence agriculture." But Chender is also beholden to his consumers, who want to see a transformed and developed India from his efforts. His complicated mission, in some ways at odds with the production demands of his investors and regulatory groups like Fairtrade, has even led to arguments with local government officials who try to encourage greater market participation. While I generally agree with Chender's point on resilience, I would add that resilience requires a flexible knowledge base.

Show farmers intersect with the learning process in interesting ways: they must prove themselves to be responsive enough to environmental feedback and prestigious enough to be followed with a degree of confidence; they must be amenable to the demands and risks placed upon them by intervention programs; and they must be personable enough to charm donors and media crews. These skills are just as important as the social and environmental learning practiced by all farmers as they evaluate seed choices, and in many instances the confounding effect of institutional payments or farm equipment overshadows the risks of new technology, to say nothing of earning local agricultural renown.

Through their experience with touring foreigners, farmers have learned when to speak up and when to defer to their handlers. In May 2014, I accompanied Gugothal to Japur, where she met with farmers who travelled to the Japur demonstration farm in the dead of summer. Recorder and camera at the ready, Gugothal grilled the farmers about their household resources, including televisions and school access (not unlike the anthropologist seated next to her). Farmers immediately answered that they enjoyed the benefits of extra income and education, an answer that failed to satisfy Gugothal – she sought a more complicated and less practiced answer. The farmers, native speakers of a Tribal dialect of Gondi, faltered in Hindi (Gugothal did not speak Telugu), leading Prakruti employee Arjuna to summarize the benefits as he sees them: food security, he asks? All agree. Seeds and leadership, he asks? All smile and agree. The conversation shifts back to topics they can explain in Hindi, especially human health and soil health. This discussion is encouraged by Gugothal's probing on environment and body, and when she compliments them on their entrepreneurship they agree. By the time that this performance repeats itself in the neighboring town of Patelpalle, Gugothal refused to stop asking questions until farmers nervously voiced their complaints. "As for me I want the truth," she explained to me later: "But if a buyer would come, I would want them to be a bit more enthusiastic [in their responses]…You've been here," she said turning to me on our long ride back to Hyderabad. "What are the benefits beyond the premium?" Most visitors do not have advanced degrees in development studies as she does, and more readily accept the performance. Those investors who want deeper connections with their farmers work with specific villages and projects. This allows show farmers to continue their performances, subsidized in various ways, as representatives of the group, and provides opportunities to the rest of the village to which the show farmers have first pick.

Show farmers and show landscapes are in one sense an extreme and directed form of social learning (Boyd and Richerson 1988; Munshi 2004). Farmers and farms are propped up by institutions not necessarily to make that particular farmer successful, but to entice others to emulate those farmers' results. They are a kind of improvement on the normal social emulation of copying one's neighbors, providing idealized models for other farmers to follow, and serving as resources or watchdogs for those farmers who are struggling. As with any social learning situation, farmers make an environmental calculus that these well-respected and successful growers must be on to something and are thus worthy of being emulated in the first place. After all, show farmers tend to be bigger, richer, and have more agricultural assets. Not only are the show farmers good people to be copied because of their social standing or farming prowess, their participation looks especially enticing because of all of the fringe benefits of their participation. Emulation then includes not just the realization that one should copy the successful farmers, but also that joining the group might underwrite some of their production risk. Those farmers most skilled in performing, epitomized by P. Mahesh of Edaggrineelu, can accumulate social prestige and lay the groundwork for a comfortable future for their families. Thus do the program incentives provide more important feedback than their own environmental success.

Such performance adds self-promotion and posturing to visitors to the repertoire of knowledge that can be drawn upon for improvisation in various ecological situations. Following Richards' (1993) focus on how farmers develop knowledge by interacting with constraints and opportunities, the didactic response, in which farmers respond to the reward structure of the intervention program that butters their bread, becomes just as important as an environmental response. They are, of course related, just as social and environmental learning are related: joining with schemes that have no lasting utility results in short-lived schemes. Thus would farmers be, at most, opportunistically showy. Kavrupad is dotted with the faded murals and crumbling facilities of projects designed to create a good photograph. The 2002 IPM intervention in Srigonda similarly gave farmers some interesting ideas that lost their lasting power with the arrival of far more accessible Bt cotton. Opportunistic show farmers may hop on board with such programs, and if they focus too much on didactic learning to appease a transient scheme, they may emerge from it just as deskilled as non-participating neighbors.

In the case of the most successful celebrity show farmers, individuals can create lucrative platforms that put the concerns of farm management on the backburner. P. Mahesh's work for PANTA and SUS has taken him and other farmers to cities and countries throughout South Asia, and he has received direct grants from the National Agriculture Bank for Rural Development as a result of his work with PANTA. As Gugothal says at the beginning of this chapter, Fairtrade or organic cotton offers the same product, with the added value of an improved livelihood, not any direct benefit to the consumer. As such, under organic production farmers are themselves turned into commodities, show farmers most of all because of their compelling celebrity. This ironically allows the image of the farmer to satisfy the need for unveiled commodities in ethical cotton marketing. German pepper consumers happily overpaid for Indian black pepper because of the environmental and social impact that they imagined their consumption was having, what Franz and Hassler (2010) call the commodity biography. Show farmer images, success stories, and media from corporate tours, as well as government grants to cooperatives like the Mahalakshmi cooperative in Srigonda, sustain organic and alternative production. That a chicken project did not cost the amount told to donors or that show farmers seen hard at work have actually retired to live on the fruits of their celerity is beside the point – their image can be bought and sold to further production.

However, it is too simplistic to suggest that farmers are simply blank slates to be consumed by foreign buyers. Indeed, the beauty of the opportunistic and celebrity show farmers is that their commodification is a calculated process that they themselves shape and can terminate when the resource well runs dry. While farmers may not always realize the scope in which their images and stories will be used, they recognize that their cooperation can bring socioeconomic benefits over the short and long term. Most importantly, show farmers learn to incorporate scheme opportunities into their improvisatory agricultural repertoire. In doing so, the program becomes yet another method by which farmers can reduce their social or economic vulnerability. Commodification is, here, a two-way street for active show farmer participants.

In this chapter I discussed how particular farmers take on the mantle of the show persona both in response to short-term gains and as a learned behavior to further a show farmer career. Show farmers also illustrate the importance of social learning in Indian agriculture because their celebrity or advocacy helps to demonstrate the potential of intervention programs in an environment defined by social learning filtered through village hierarchies. Show farmers may have their production risks underwritten, but their professed faith is crucial to development programs in the larger village.

In the next chapter, I will discuss the role of performance generally among the larger farmer population as it interacts with development programs. Specifically, I focus on the ways in which this performance manifests in farmers as a narrative of transformation. While show farmers take the narrative of the transformed farmer subject to an extreme, all farmers participating in organic projects or GM development must deal with new markets and new production methods to some extent. I draw on the narratives of farmer voice offered by farmers, plant scientists, industry representatives, shop owners, and researchers to see how farmers align themselves with the notion of their transformation into better farmers as a result of technological interventions. This transformative sentiment is of course strategic and performative as it allows farmers to perform the roles expected of them by outside experts or consumers and required of them if they wish to reap the benefits of NGO, corporate, or scientific institutions. But just because this sentiment is performed, I do not want to dismiss it out of hand as lip service. Farmers are rewarded in a direct feedback loop for performing this ignorance and as such it becomes part of their learning process in a socially embedded agriculture. The idea for this chapter was suggested to me by a number of organic farmers who professed to their profound ignorance of seeds and management before their program began, just as Escobar (2011) and Gupta (1998) observed farmers rushing to declare themselves as new and modern subjects. However, I also observed this mentality among farmers who praised Bt seeds and the intervention of government or university extension programs, where their transformative attitude was more overtly linked to the benefits received from assistance schemes.

Chapter 9: Transformative Sentiment in Intervention Programs

The hamlet of Edaggrineelu is several kilometers from reliable bus or auto transport, and so I found myself walking out to the crossroad to wait for a bus with Kanka on his way to Jenagom – he knows all the shortcuts. His brother, employed part-time by the NGO that introduced organic agriculture to this town of forty households, had left us but Kanka offered to lead my research assistant and me back to town. As we walked, he talked about the impact that the NGO had on their lives and on the village. His brother is employed by PANTA, and he takes the view that the NGO has been good to the farmers, offering advice that has brought them fame and expertise. But he also speaks with a practiced certitude about his experiences, shaping them into a before and after narrative. He mentions how often he has been interviewed, that he's nearly as famous as the charismatic village leader, Mahesh, who is championed on the NGO website and in numerous news reports. I was goading him, trying to ask if he used any methods or materials outside of what PANTA was telling him to do. He shrugs this off, saying, "If PANTA didn't tell us to do something we don't do it. They're so good to us, why would we want to change that system?" "What about seeds?" I ask, trying to gauge his opinion on the free cotton seeds and accompanying management advice offered by the NGO. Through the organic program, the farmers of this village are only offered two seed types, far less than the hundreds of choices they would find in a seed shop. "Before [PANTA] we spent all our money and we didn't know how to plant" he answered dismissively. "We used to be stupid and plant rice only for selling, we never planned according to the seasons…they only give good seeds."

I was taken aback at his suggestion that farmers didn't know how to plant and plan according to the seasons – what farmer would know so little about the fundamental agricultural input, let alone admit it? The farmer of course was performing a role, that of the transformed farmer subject. In the accompanying narrative, the village used to be a place of superstition, waste, and poor judgment. Since the intervention of the NGO, the farmers have learned to save, to eat their own products, to plan for the seasons, to be, in essence, 'good' farmers. While the show farmers described in the following chapter take the narrative of the transformed farmer subject to an extreme, all farmers participating in organic projects or development generally must deal with new markets and new production methods to some extent. Through this interaction they encounter a variety of experts who guard the floodgates to farm equipment, seeds, loans, and assistance programs. Thus does knowledge of agricultural production and the authority that accompanies its ownership create relationships of deference and obligation between farmers and their respective developers.

This chapter considers the role of *transformation* in the agricultural development experienced by farmers in the Warangal and Addabad districts of Telangana. Both GM cotton seeds and organic agriculture are part of an agricultural development integrated through a series of state, corporate, and non-profit incentives: state subsidies on GM seeds, pesticides, or fertilizers; a slew of state and private sector programs that require farmers to navigate a confusing and inefficient bureaucracy to gain access to low-interest loans or farming equipment; and an extension industry that offers access to these resources and solutions to new problems. In engaging such development, proponents and opponents argue that farmer subjects become transformed – like Kanka, they claim to have passed from ignorance to a more conscientious understanding of their work. In this chapter I argue that this well documented and promoted transformation is performative and therefore contingent. In performing gratitude or a transformation from ignorance, farmers reaffirm access to extension services or please program officers giving tours to interested buyers.

It is not new to say that organizations use narratives from people on the ground to show how their products or services are changing lives. However, the anthropological question asks what effect this interaction between farmers and intervention programs has on the people involved. Erica James (2010) discusses the way in which Haitian refugees learn to shape the experiences of their trauma into legible narratives that can be readily understood and thus smooth the path to international aid money. Like the show farmers described in the previous chapter, the best performers can garner more of the available funds. Following James I use the metaphor of performance here to refer to the way in which farmers profess to be transformed in some way by organic or genetically modified technology packages. Like the deference that many informants tend to show researchers, this performance breaks down under further investigation and probing. Farmer respondents who initially professed that organic programs taught them to fertilize their fields or that they chose GM seeds after careful deliberation later admit that these insights depend more on the discounts offered by shop owners and program directors. I will begin by reviewing scholarly perspectives on farmer-subject transformation, discuss these dynamics in the Warangal and Addabad districts, and then show how different kinds of programs create different rewards that farmers learn to perform for. I conclude by fitting the experiences of performing farmers into my larger arguments about the creation of knowledge on different kinds of farms.

Transformation Through Development

Stories of transformative experience are common in development literature. As Escobar (2011) notes, experts require quantifiable, legible problems that can be analyzed and solved. Agricultural development as described by Escobar (2011) and Gupta (1998) seeks to learn problems, classify them, formulate solutions, make policy, pass judgment, forecast the future, and cast these solutions and problems as scientific and thus teachable to farmers. Viewing transformation as a role performed by all farmers, I draw attention to the role of didactic, moralizing instruction in the organic and GM farmer learning process. In an environment dominated by education, intervention, and interrelated packages of agricultural technology, farmers are neither hybridizing tradition and modernity nor fully transformed into new kinds of people. Where hybridity or the creation of a new self suggests a permanent subjective shift, I argue that farmers learn to perform certain kinds of roles that provide access to different kinds of infrastructure, markets, social capital, or economic safety nets. Through the learning process, they can test the waters of transformation, performing roles that secure short term gains while keeping an eye to the future. Such roles are based in their interactions with a variety of players including fellow farmers, field officers, cotton buyers, and researchers.

Seeing the awkward and uneven adoption of scientific methods and knowledge in postcolonial India, scholars (Gupta 1998; Vasavi 1999) suggested that farmers hybridized knowledge between a traditional Ayurvedic-based understanding of agronomy and the new scientific methods. But while explaining the persistence of Ayurvedic logic in farm management, the notion of hybridity poorly accounts for the role of performance as farmers learn to navigate new institutional risks and rewards when working with extension programs. While accounting for the socially embedded logic of technology, such as chemical fertilizers, the hybridity lens distracts from the ways in which farmers themselves adapt to new systems of knowledge. Moving away from hybridity, which suggests a collision of rigid forms, Escobar (2011) returns focus to the farmer practitioners themselves. Farmers selected for field schools or working with extension officers are given new authority and instilled with the virtue of development. They become transformed by the program and "begin to interpret their lives before the program as filled with ignorance and apathy. Before the program, they say, they knew nothing about why their crops died; now they know that the coconut trees are killed by a particular pest that can be combated with chemicals" (Escobar 2011:51). Escobar, while clearly critical of this transformation, observes that farmers do transform, taking on a new sense of self promoted by the Colombian state, embracing consumable agricultural products and respecting the authority of agriscience experts.

Although they disagree as to the ultimate effects of such interventions, Escobar agrees with pro-intervention authors (Duveskog, Friss-Hansen, and Taylor 2011; Mancini, Van Bruggen, and Jiggins 2007), some of whom go so far as to argue that agricultural interventions are a kind of transformative learning (Mezirow 2000) that changes farmers' outlooks on life. One study from Kenya highlighted personal transformations including renewed confidence in one's abilities, improved work ethic, improved Christianity (whatever that means), a shift from cultural restrictions and taboos to inclusivity and Western rationality, a change from witchcraft to scientific crop-management, and the report from one farmer that in the past they "were just farming carelessly, but now we are farming for business" (farmer participant quoted in Duveskog, Friss-Hansen, and Taylor 2011:1539). Kanka espoused a very similar sentiment in our conversation above. Such a perspective takes the farmer transformation at face value, an almost religious implication that farmers see the light and are converted to the values espoused by development discourse (Gupta 1998; Escobar 2011; Pandian 2011; Kothari 2005): the new, modern, scientific, consumer, liberal self.

More critical of the social context of this transformation Agrawal (2005) speaks of this transformation as more of a shifting calculation of self-interest, which accounts for the contingency of that transformative sentiment: farmers in the forest areas of North India transformed from forest burners to forest conservators, but only after they came to see environmental discourse as in their own economic interest. Seizing upon an advantage, his forest-farmers then internalized that economic interest as a form of conservation self-discipline. While I largely agree with Agrawal that farmers come to view their relationship to environmental management as a result of the reward structures of the institutions with which they work, I argue that the actual transformation is a role performed by farmers as they present a version of themselves to navigate everyday life (Goffman 1959).

Whether they are promoting didactic farmer inventions (Duveskog, Friss-Hansen, and Taylor 2011; Godtland et al. 2004; Mancini et al. 2008) or critically placing the assumptions of international development within an Orientalist, paternalistic relationship between advanced capitalist states and developing nations (Escobar 2011; Gupta 1998; Pandian 2011), authors discussing educational interventions in smallholder agriculture accept that farmers are transformed by the experience. The intervention has the effect of reordering the farmer subject toward modernity or maturity (Agrawal 2005; Escobar 2011; Pandian 2011), or is perhaps hybridized into some awkward new subjectivity when considered in tandem with the previous way of doing things (Vasavi 1999; Gupta 1998). Meeting new visitors, farmers initially espouse this view as illustrated by the Kanka above. However this transformative sentiment appears to be strategic and contingent, lacking the permanence implied by Gupta's hybridization thesis described above. It may be more accurate to call this sentiment performative as it allows farmers to perform the roles expected of them by outside experts or consumers and required of them if they wish to reap the benefits of NGO, corporate, or scientific institutions. Just because this sentiment is performed, I do not want to dismiss it out of hand as lip service. Farmers are rewarded in a direct feedback loop for performing this pre-transformation ignorance and as such it becomes part of their learning process in a socially embedded agriculture. I also observed this mentality among farmers who praised Bt seeds and the intervention of government or university extension programs, where their transformative attitude was more overtly linked to the benefits received from assistance schemes.

What these authors (Agrawal 2005; Duveskog, Friss-Hansen, and Taylor 2011; Escobar 2011; Gupta 1998), state scientists, private consultants, NGOs, and farmers themselves call transformation appears to be an institutional rewarding of a kind of performance in this didactic learning environment. Just as overreliance on social emulation exacerbated agricultural deskilling among GM cotton farmers, an overreliance on didactic knowledge appears to be further destabilizing farmer knowledge on both GM and organic cotton farms. Farmers involved in such systems are not rewarded for careful long-term environmental management but for following the instructions of experts with whom they work. In this chapter, I draw on the narratives of farmer voice offered by farmers, plant scientists, industry representatives, shop owners, and researchers to see how farmers align themselves with the notion of their transformation into better farmers as a result of technological interventions.

GM and Organic Interventions as Vehicles for Transformation

Central to the transformative experience is the agricultural intervention, which comes in the form of various technologies or educational services. GM seeds are themselves one kind of intervention, and fit well into the pattern development described above: the problem, insect predation in cotton, can be solved by purchasing a foreign technology, a genetically modified Bt seed, which responds best to the regimen of fertilizers and irrigation developed during the Green Revolution. The actual management of GM seeds in Indian smallholding agriculture, as has been discussed at length, has had mixed effects for this system. A farming extension industry has rallied around helping farmers use this technology, despite claims that GM seeds would require no additional changes on the part of the farmer (Thaindian News 2008).

The Warangal public agricultural university system, ANGRAU, has a complicated, even contradictory set of extension services. Breeding programs do not fund Bt cotton programs because they do not have the corporate permissions required to work with that technology, but individual scientists do offer call-in services and consultations for GM farmers. More of their work involves breeding non-Bt hybrid strains, although the client base for this must be small in a context of over 90% Bt adoption. One such ongoing experiment examines the effects of high density planting on yield performance and pest insect attacks. If successful, the research station will recommend that farmers plant their cotton seeds more closely, requiring that double the amount of seeds be purchased. In addition to this non-Bt work, the research station also leases land to private seed companies for Bt cotton field trials, helping hybrid companies evaluate their seeds without having to build separate field facilities.

"Scientists?" Raju, a farmer from Srigonda, snorts derisively. "We call but they never come. The scientists know things that they read in books, but we farmers have all the practical knowledge." Although farmers lambast the plant scientists as unwilling or unable to give advice, the Warangal research station scientists give farmers their personal phone numbers and field questions both individually and through a data processing service. They also provide access to government services: In 2014, the newly elected Telangana government subsidized drip irrigation, prompting plant scientists to inform farmer friends and encourage them to adopt the technology as a part of a largescale *in situ* trial. Other collaborations include the founding of a farmer's cooperative in Srigonda where ANGRAU crop scientist Umesh Reddy served as a scientific and bureaucratic liaison to the resources and expert knowledge of the plant research station. This gave local farmers the opportunity to travel to the regional office of the joint director of agriculture, a gatekeeper for state agriculture resources.

Undeniably, Bt cotton is growing in approximately 90% of Indian cotton fields (Cotton Corporation of India Ltd. 2013; The Hindu Business Line 2013). More debatable are the reasons for this popularity and the extent to which it represents a free-market choice of a superior technology. Although the early spread of GM cotton was presented as a solution to an agrarian crisis characterized by farmer suicide and pesticide overuse (Pearson 2006), farmers are now celebrated for the wisdom of choosing Bt cotton: "The unprecedented high adoption of Bt cotton is due to substantial and significant benefits to farmers, successful control of dreaded bollworm pests, benefits to industry…the farmer is wiser than me" claimed Indian agriculture minister Sharad Pawar in a 2013 interview (Mohan 2013). Monsanto India Region lead G. Shankar agreed, arguing that farmers had trialed technology, reasoned that Bt rose to the top because there were so many viable options:

> What happened in a particular area was that if a particular seed did well farmers had a tendency to go for that seed in the next year not realizing that in the next year the climate might not be same. But my observation is more that the farmer is not now relying on one seed. He buys three of the most popular varieties and depending on which does well on his farm he sees the difference and buys that the next season. But you're right. There is a tendency to switch over and also a tendency to have more variety. But I don't think, you know, that is a big problem because now as a farmer I can get at least one seed. What they're doing is they're not putting all the acres to one seed. And in their own way they can get to their own experiment to say which will work for their farm.

As plant scientists, representatives from the Warangal plant science station, Monsanto India's farmer outreach programs, and private extension service E-Digu have to manage a balance between celebrating the knowledge and wisdom of their farmer clients, expressed when the farmers use their technology, and insisting that they can offer consistently useful advice.

Monsanto India, which promotes Bt cotton's high adoption rate as proof of its benefit to farmers (Monsanto Company 2012; Monsanto Company 2008) runs its own call center, the Monsanto farm advisory service. "We already have a million corn and cotton farmers and vegetable farmers enrolled in our system," boasts Shankar. When asked where farmer knowledge was strong and where it was lacking, Shankar answered that larger farmers who watched television, interacted with scientists, and above all conducted soil tests were better equipped to manage their farms. The challenge, then, is to bring the remaining farmers into the fold. E-Digu, a remote extension service sought to translate this "last mile" of agricultural extension, the last communication barriers between farmers and agriculture scientists (Venkata Ratnam Bachu, Krishna Polepalli, and G. S. Reddy 2006; Stone 2011b). To this way of thinking, the technology and advice were sound but the farmers were incapable of fully understanding their advice. "The farmers are not educated enough to trust scientists and therefore over-rely on neighbors and shops," echoed plant scientist Dr. Ranitha of the Warangal Research station.

For all their insistence on educational intervention, E-Digu, Monsanto, and public research stations inevitably lead the farmers back to shops. While no advice is directed toward specific shops, and some non-chemical management advice is given, the intervention that these services provide largely directs farmers to apply some kind of purchased input. E-Digu, for example, has a policy of providing an example of a brand name pesticide that the farmers could use, along with the chemical name in case the farmer chooses to investigate by chemical. Development institutions are in this sense pathways to purchased solutions to agricultural problems. Even less commodified suggestions, such as planting density, are not themselves requirements to purchase products but would effectively ask farmers to buy a greater quantity of seeds. As imagined by officials like Pawar, a farmer purchasing a GM seed or the correct chemical is seen to be transformed from an ignorant and superstitious person at risk in agrarian crisis to a rational consumer exercising his choice in a free market.

Within organic agriculture programs, public and private interventions are more focused on bringing farmers into compliance with certification or marketing initiatives. Rather than trials or call centers, organic interventions often take the form of show farms or farmer field schools. These development initiatives teach farmers to use input unintensive methods much as former officials taught them to use input intensive methods. While the idea of experiential learning is certainly not new, farmer field schools (FFS) emerged as agricultural development tools in 1989 in Indonesian rice fields to combat overzealous pesticide use that led to resistant pests. The first field schools promoted Integrated Pest Management (IPM), as a means to educate farmers to the point that they "became "experts" in managing the ecology of their fields - bringing better yields, fewer problems, increased profits and less risk to their health and environment" (Braun and Duveskog 2008:3). Field schools seek to build self-confidence, problem-solving skills, and encourage empowerment (Braun and Duveskog 2008; Duveskog, Friss-Hansen, and Edward W Taylor 2011; Van den Berg and Janice Jiggins 2007). In the Warangal district, several teams led by Mancini (2009; 2008; 2007) argue that IPM FFS lead farmers to better lives, enhance well-being, reduce pesticide use and pesticide poisoning, and encourage greater economic resilience.

While low input technology field schools do not commodify knowledge in the way that Bt cotton commodifies pest resistance, the international NGO network and neoliberal organizations that fund these projects rely on success narratives, morally "transformed" (Duveskog, Friss-Hansen, and Edward W Taylor 2011) farmers, and triumphant photographs for donor money. In this way, the same farmers who use transformation as a way to get ahead in agriculture willingly allow their images to become part of the NGO agenda. Whether they know the ultimate purpose of the media at the time, farmers accept that their participation involves their image becoming a commodity sold to donors who invest in new projects that generate new developed subjects.

Both Prakruti Organic in the Asifiabd district and PANTA' Edaggrineelu village in the Warangal district promote the transformation narrative through their social media, marketing, fundraising, and promotion of their programs. To justify the intervention, organic programs draw on narratives of crisis that give way to an intervention and result in transformed farmers making more money, doing better work, or taking better care of the environment. This is not to say that the communities in question do not experience poverty or crisis. However, I would like to draw attention to the way in which this is a necessary predicate for the organic intervention. "Mainly its about crisis," explains Prakruti employee Sama. "These people they don't have access to resources actually. So in a way they're resource poor farmers compared to other farmers in the main lands where they have access to marketing and all. So these people face a lot of exploitation. We want to address the issues related to these problems. That's why we are working there." VG Ramesh, director of PANTA' parent organization, SUS, agrees: "We choose villages that are in deep crisis. That's the first target we have. So all our projects are located in areas where there is a high use of chemicals, we don't go to villages, regions which are already low in pesticide use."

Prakruti's Facebook page offers hundreds of photos lauding education programs and the donation dollars that make those programs possible. Visiting donors are offered the chance to dedicate mango trees or science labs that will someday help to bring those communities out of poverty, as described in the following chapter. In a promotional pamphlet entitled "Fashion to Field", Prakruti stresses both that their products are of a high quality and that farmers involved have learned through “the unique concept of conducting Farmer Field Schools (FFS) trainings, where a technical expert is accompanied by the farmers of a village to their fields. Knowledge from the FFS then spreads amongst the others in the village through regular meetings of the self help groups.” A farmer testimonial on the cover shows that “Over these years with Prakruti we have realized the significance of quality…complying to the standards of certification are no more a burden, rather a customary practice of our lives.” Surely, before working with Prakruti, the farmers understood that quality was an important factor in their cotton production. But the farmer testimonial underscores the importance of transformative sentiment. Thanks to your help, the farmers seem to be saying, we have changed our methods and mindset.

Because of its traction in sales and the symbolic work it does in justifying interventions, the notion of transformation can be even more important for organic programs than the actual technology that they promote. To make consumers care about the issues of social transformation or environmental protections in Edaggrineelu, Ramesh explains that his work is as psychological as it is agronomic. PANTA aims to create “a confidence in the people. You see, it’s not just about giving [the farmers] seed. By giving them seeds we cannot solve the problem, not unless we create an ecosystem where farmers understand and do it on their own.” Earlier in our interview he argues that yields, one of the key tropes in GM cotton adoption, distracts from the real work of farming. “I feel farmers have been fooled into, and they’re driven in terms of, adapting technologies in terms of higher yields. I think that’s a wrong mechanism. And if farmers understand the economics and then plan accordingly [with organic technology] their yields should be perfectly fine.” While representatives from Prakruti or PANTA would probably not address their work in such terms, interventions that deliver “confidence” or “understanding” fit into the same transformative learning model described above by Duveskog, Friss-Hansen, and

Taylor (2011). This narrative is then repeated in media reports, where farmers shift from a marginal, at-risk population to landscape managers who "realized the importance of natural and common resources for sustaining their own livelihood" (Prabu 2013). Rather than accept this transformation at face value, it is illuminating to focus on the way that farmers learned, or failed to learn, to perform it, and what kinds of social or material rewards they receive in return. The following section reviews farmers' experiences as they perform transformed identities, paying special attention to what they receive within various programs as a result of this performance.

Performing Transformation

I will begin with examples from the organic farmers of Edaggrineelu and then move to the experiences of farmers working with the Prakruti Organic villages. Then I will talk about the analogous kinds of performance in GM villages. The vignette that opens this chapter ranks among the most dramatic and overt display of transformative sentiment performed by the farmers that I observed, but it is not an isolated case. Because the program is uncertified, Edaggrineelu farmers correctly recognize that their continued success with organic programs is determined in part by their performance to the more than 10,000 visitors who have come to learn from Edaggrineelu's example since 2006. As reported in national media and environmentally-inclined magazines, Edaggrineelu's origin story begins with a crisis of red hairy caterpillars (*Amsacta albistriga*) in the mid-1990s. As expensive pesticides stopped working and farmers looked down the barrel of crop failure, their desperation drove them to try experimental non-chemical approaches. These ultimately proved so successful that by 2006 the entire village had transitioned to become fully organic. When visitors come, they see a place where "mostly backward castes" socially regulate the community to "ensure that there are no erring farmers"

(Prabu 2013), and "organic farming has created a balance between friendly and harmful pests" (Misra 2009). Thanks to "constant motivation by the NGOs" (Venkateshwarlu 2006) PANTA' work has ensured that Edaggrineelu "stands out as a beacon of hope" (Venkateshwarlu, Balloli, and Ramakrishna 2008:171) amidst a sea of agrarian distress. This publicity and attention helps to attract the visitors, who sometimes pay up to Rs1000 (~$17) per person. Visitors include members of the legislative assembly and, more importantly, movie stars, since they declared their organic intentions. Others come simply to buy food. 'Want to buy some rice?' I was asked my first day in town.

Here, transformation for this relatively isolated village of mostly low-caste farmers hinges on their rejection of pesticides in the wake of a mid-1990s insect pest crisis. "Not only are they scientists and know everything", explains Siddalu, "but [the program director] has 50 acres and is a farmer." Raju, sitting nearby agrees: "What we had done [before 2003 when he switched to organic methods] was totally a waste, we didn't know how to use hen manure, lake soil, or vermicompost. We were using chemicals and thinking that if our neighbor used one spray, we should use two! We had a lower yield, more diseases, and we had to spend extra money on the chemicals. Before we learned to use [the System of Rice Intensification (SRI)], we were putting manure directly into the land because we didn't know any better. Now we can use our own resources like manure and vermicompost."

Although both PANTA and Prakruti professed that they target farmers in crisis who they feel are more amenable to change, Prakruti's Addabad district organic farmers are additionally appealing to the NGO because they belong to the historically marginalized Gond Scheduled Tribe (ST). Tribal farmers in this part of India live in comparatively less developed hamlets on more marginal land, and do not belong to the larger caste system. Such disenfranchised farmers present an appealing image to donors and ethical consumers trying to use their money to have as large an impact as possible, hoping to connect to farmers (Guthman 2009) through the long and foggy cotton commodity chain.

Change and transformation for the Prakruti farmers is more consciously about the infrastructure given by the program and the economic opportunities the program offers. Through Prakruti these farmers have become entrepreneurs, consumers of a debt-free technology and producers of an efficient product. Devarao, who manages five acres, argues that Prakruti has allowed him to avoid the dependencies that he sees in other villages:

> We didn't know how to do those things before but now we're planting in a good way… Before we didn't know about sprays or about making our own sprays, and before the investment was much more without any big difference in yields. Those who work hard can only ever get good yields, including those who take chemicals, but there the investment is so high that the yields must also be high at any cost. If I use [chemical fertilizers] it'll work for me this year but over time what kind of land will be available for my son. After this year if I put 10 bags, next year I need to put 20. If I put 20 bags the following year I'd need 30. If you use them one time you must use more in the next as the strength of the land decreases. In my own land I've seen it and in others, if you use once must always use them for fertility. Only [cow manure] will fix it and only slowly. In this village almost no one ever used it so we were spared from that, but in my ancestral village the situation is like that."

This transformation hinges on the seeds provided at interest-free credit by the organic program, the production of home-made organic pesticides, and a regimented fertilizing program. "There's no need to change from anything they tell us as Jangu, Krishna, and the Sarpanch (two organic field officers and the local political leader) are our organic leaders and tell us correctly…With all the investments those sprays and fertilizers aren't really worth it, even though we see others with bigger yields." The seed choices or management decisions that so perplex many GM farmers have no relevance for organic farmers, who are limited in the seeds given to them by their program officers. "Before Krishna came we bought seeds in the shops without any kind of guarantee. Krishna gives only good seeds”, Prakruti farmer Ataram Manku informs me, adding that “if we complain [about failed germination] they’ll give us new seeds but it’s not necessary yet”. In the late monsoon of July 2014, Prakruti compensated for failed germination first by insisting that farmers wait to plant and then, after the farmers ignored this advice and used their usual timetable, providing extra seeds to their constituent villages. “Before organic we didn't know about these leaf sprays, nobody told us,” began Prakruti farmer Sone Rao. “But surely you knew there were insects and that they were eating the cotton,” I challenged. Okay, he conceded:

> We knew that the pests were there, but we didn't know what sprays worked for which pests and which different pests were doing what. When I was small there were no insects and no facilities like schools or buses, so everyone did the farmwork. We healed ourselves with local medicines from the forests and people weren't sick like today. Now there are hospitals, no one wants to do farmwork. They want to leave the village and go to school, they're sick in hospitals not using our own medicines. Before no crops needed fertilizers or pesticides, but now they all need these, these urea and others have made the plants weak.

To hear him explain this situation, his transformation has wrought positive and negative changes. On one hand, the scientific understanding and the novelty of formal pesticide applications has allowed him to increase yields and feel as though he better understands his field’s agronomy. On the other, that scientific understanding has come at the cost of a dependency on purchased inputs just as the knowledge and labor base for the next generation is migrating away from the village.

Like the Colombian farmers that Escobar (2011) describes, the farmers present the past as a place of ignorance. Prayer, offered scathingly by program officers as the default non-organic solution, nonetheless appears to influence field management decisions. “They would just pray to the gods whenever something went wrong”, says field officer Krishna, clasping his hands in mock prayer, “they did rituals and didn't do any spraying or fertilizing, just hoped that it would work well." Yet planting days still coincide with celebrations of gods that bring rain; religious songs and dances ask gods for help and are documented for organic promotional materials; as in many parts of rural India, village gods hang from trees and roadside shrines. "Our grandfathers worshipped these gods and we can't forget that tradition", offers Prakruti farmer Chandansav.

Although it can be difficult to differentiate between the performances of transformation that I describe and normal interactions in the context of our social distance, the notion that farmers were previously incompetent or ignorant of agriculture dissolved under deeper anthropological inquiry. What do you mean you didn't know how to farm for profit before? How did you fertilize without using manure? What's wrong with praying to the gods? And most notably in Edaggrineelu, where do you get all the manure you need for you land if you've sold all your cattle for tractors? In Edaggrineelu, the PANTA goes so far as to bring seeds and inputs to the village, saving close to Rs 100 for each farmer in transportation costs per trip. More than half of the farmers took advantage of this program, explicitly following not environmental feedback but PANTA advice. "PANTA only gives good seeds", one farmer explained, a sentiment expressed by many of the farmers, despite the fact that farmers who received seeds from the NGO had almost identical yields (4.33 quintals per acre from outside seeds compared to 4.48 quintals per acre from PANTA seeds) than those who bought their own seeds. Despite claims that farmers have abandoned machinery (Misra 2009), this small village of forty households without autorickshaw stands or a bus route boasts seven tractors, PANTA helped to negotiate the heavily subsidized purchase of a seed cleaning machine, and the local government school is shuttered because the village sends all of their children to a private school offering English medium classes.

GM cotton farmers by and large do not perform for or depend on international donors. Beholden to shops and agricultural extension officers, they perform transformation for neighbors and fellow farmers by extolling the virtues (or shortcomings) of GM seeds and their own prowess as seed consumers. It is common for many farmers to plant more than one different kind of cotton seed in their fields, on average 2.41 and 2.32 different cotton seeds per farmer in 2013 and 2014 respectively. Farmers report that they do this so that they can gauge the difference between different seeds and then make a decision about next year's planting. According to the farmers, such comparisons are possible because almost everyone has the same conditions of soil, pesticides, fertilizers, and labor to deal with. When I said that I was having difficulty asking farmers about their seed choices, Kishor of Ralledapalle consoled me by saying that that the "other farmers in the village are drunk fools, or that they're rich and don't know their own land." Unlike himself, such people can't be expected to know the answers of how to solve these problems and conduct proper tests of the cotton seeds. Ironically, he himself works as an electrician and laborer in Saudi Arabia, often leaving his wife in control of the farm.

Other farmers celebrated their close relationships with experts or educated children. "I always know which seed will be best," boasted Chandraiah of Kavrupad. "Both [a local shop owner] and I are well educated and wealthy, why would he mislead me?" This class and status celebration is mirrored by the uneducated farmers who claim that they are better off listening to shops and large farmers because they have no such knowledge. "If you're sick, you go to the hospital, right?" answered Muramma when asked why she travelled to the seed shop for seed advice. Pesticides, locally referred to as *mandulu* or medicine, appear to be the purview of shop owners. Many farmers can relate stories of buying a small or cheap pesticide at a local store and discovering the morning after spraying that the insects remained on the plants. In exchange for a photograph with his prized bullocks, Dasru allowed me to watch as he took over four hours to spray his six acre field. Worried that the monsoon rains would wash the pesticide off the cotton, he had hastily bought a cheaper generic brand pesticide. “It was a waste”, he told me bitterly a few days later. The pesticide had only killed about 30% of the insects and he had to travel to a larger town with a better agricultural shop to buy a more powerful pesticide. What can you do in this situation, I asked. “Go to a shop to get a new suggestion and if the local shops don't work go to [nearby larger city] Nekonda for a *pedda mandu* (more powerful medicine). If you get an injection from the doctor and you don't heal, its not the doctor's fault,” he reasoned.

Because the farmers knew of my interest in Bt cotton and their experiences with it, some relayed transformative experiences that occurred with the new seeds. One common response held that Bt cotton had been good and very successful for the first several years that it was on the market. “I would have committed suicide if not for Bt seeds” recalls Venkateshwarlu, a large landowner renowned in Kavrupad as a hard worker. The cotton helped him reduce pesticide sprays and provided several years of consistently improved yields. “It made my life easier and is a big improvement” agrees Dasru. But recently these changes have taken a downturn. “The bitches are putting less [of a Bt dose] in it each year,” complains Dasru’s neighbor, Ramulu.

The performance of transformation requires that organic and GM farmers seize upon new technologies enthusiastically, claiming that life before the intervention was dark and ignorant. In exchange, organic farmers from Edaggrineelu get to bask in the gaze of thousands of visitors and lucrative opportunities. For the Prakruti farmers, their performances help to cement the media produced by Prakruti and foreign visitors who sell their cotton. The rewards are less overt for GM farmers celebrating their seeds and conducting careful, if unhelpful trials of seeds, but these farmers associate the new technology with the science and success celebrated in news programs and extolled by their newly educated children. Even in the face of failure farmers were largely unwilling to blame the shops and products themselves, acknowledging that, even if the scientists did not have their best interests at heart, they still needed their help to buy products. In the shops, low caste or poor farmers needed to show the necessary deference to the high caste, wealthier shop owners. Wealthier farmers similarly performed their modern, scientific knowledge by trusting friends and contacts in shops and universities. However, as suggested by Ramulu's comment above, all of these social performances are contingent on the benefits of working with shops, extension agents, and program officers. The next section explores the consequences of turning one's back on the stage.

Incomplete Transformations

The contingency of this transformative sentiment can be seen among those organic villagers that quit organic programs and by the fate of the intervention program E-Digu. In organic villages that do not see the promised yield or infrastructural benefits from their participation, farmers often leave the program or bend the rules. These farmers are by definition marginal to the project, less personally invested in its success or less socially connected to the program managers. When such farmers leave the project, their knowledge of seeds and marketing is even worse than that of the regular GM cotton farmers because they have no neighbors to ask or first-hand knowledge to rely on. Instead, their information comes from impatient shop owners selling seeds who give little, if any, management advice.

In 2012, fifteen households in the Gondi Tribal hamlet of Ranaguda began a mandatory three year conversion process to transition to certified organic agriculture. By the following year the farmers were generally irritated with Prakruti. We only do this, one farmer grumbled, “because Prakruti is giving us cheap seeds, but the yields are poor and the profit margins are even worse: a small premium combined with a small yield. Their rules are complicated, they are banning the [fertilizers that would give a] solution [to the yield problem], and if we use them they won't take our cotton.” To satisfy the certification requirements of foreign buyers, organic farms follow procedures outlined by the United States Department of Agriculture, which have become a template for organic production around the world. As such, Prakruti cannot sell organic cotton as such or provide the promised premiums until after the transition period, placing farmers in an uncomfortable double-bind where they must suffer comparatively lower yields from non-GM seeds grown without chemical inputs and receive no price premium. Contrary to the farmer’s opinion, Prakruti does buy non-organic cotton and sell it on the open market, but the farmer is correct to note that his family receives no additional income for the trouble of organic production.

In 2013, four of the households maintained Bt cotton on separate fields, affirming to the Prakruti that they used separate farm tools to manage the Bt and non-Bt fields and kept the harvested cotton separated. In practice this separation is impractically difficult to achieve, and so the NGO maintains that they certify land, not farmers. This can lead to awkward paperwork in which members of the same household manage officially separate farms. An additional five households did not know the names of the seeds that they planted, claiming that “Prakruti gives the seeds, we take what they give and we don’t use chemicals on that land.” Returning to the NGO office after a day of interviews, I mentioned that a number of Ranaguda farmers were planting Bt seeds, an infraction that could violate the letter, if not the spirit, of organic production regulation. Arjuna, the NGO’s district coordinator, grew irritated and advised me to try other farmers where I could find “better information.” “Don’t talk to them, they are only transitioning", he informed me. After all, what organization would not rather have visitors see their show farmers (see chapter eight) than their most marginal farmers? "Oh, it's no problem," I said, feigning ignorance of his discomfort. "This will help me understand how farmers make the jump to organic cotton."

A year later, I was back in the office expressing my surprise that all but two of the Ranaguda farmers dropped out of the program. "They are defaulters", lamented Arjuna. For three years the farmers took loans, plants, farm equipment including plastic drums, seeds, and participated in a government assistance program brokered through Prakruti. For three years they claimed that they could not afford to pay back their debts to the program. "We couldn't pay", says Saraswathi. "We lost the entire crop last year and there was nothing to be done." As a farmer of over twenty acres and the owner of a local shop, I have doubts that she could not have repaid her debts on four acres of cotton, but she certainly refuses to do so. "They're still interested" mused Arjuna, "but we've stopped giving them things as they aren't paying us back." The combination of heavy rains during last year's harvest and the late El Nino monsoon of 2014 led many farmers to question his efforts, and he confides that in such difficult years he must keep a closer watch on all the farmers to ensure their compliance. That is, he must make sure that they are following didactic instruction rather than following a more flexible system based on what they themselves think is best. Have you seen the cooperative land, he asks?

> We want to make it a better demonstration area but we're having a money problem. We need to show the farmers how to do everything, even after ten years they are still not always following our rules and they are getting confused. These Tribal farmers, you can't just say once, you have to say two, three times, and you have to show them everything, that's why the land is so important. They have gotten trainings on insects and sprays and soil, and now those things are improving, but we need to give them training in business too. This area is very good for the organic farming because we can show them what to do and how to do it. That support is necessary.

In 2014, only four out of twenty-four cotton seed choices in the village, representing two farmer households, planted non-Bt seeds from the organic program.

In 2013, with the continued support from the NGO through government assistance, farm equipment, seeds, and training programs, the Ranaguda farmers were willing to humor the management demands placed on them. Yields are bad, the farmers told me, but they were bad in the past as well. “Now we have the sprays from Prakruti and we know how to plow and properly prepare the cow manure”, one farmer told me, espousing his transformation. “The DAP and urea hurt the land and cause it to lose energy”, said another, repeating a Prakruti talking point I heard in all the villages. “Now we know better”. By 2014 that sentiment had evaporated. “Prakruti stopped giving so we stopped taking” shrugged Saraswathi. “We tried organic for three years,” she explains: “In the first time it came very well, but they kept giving the same seed, so the yield went from fifteen, then ten, and then last year two quintals per acre. It's probably a fault of the manufacturer rather than Prakruti, but we don't want to take from them anymore.” In the absence of clearly defined rewards, and considering their own poor experience with the seeds, the organic farmers in Ranaguda no longer had any reason to talk about their transformation and the education they received at the hands of the program.

Edaggrineelu sits a twenty minute walk past another village, also full of farmers. “Are you going to Edaggrineelu?” asked village teenagers passing on the way to the main road. When I answered in the affirmative they rolled their eyes and laughed. “Everyone always goes to them, no one ever comes to see us. Please, they spray at night.” Inter-village jealousy aside, several farmers admitted spraying pesticides in extreme situations and I noticed pesticide bottles in household trash piles. In 2013, at least six farmers in Edaggrineelu admitted to planting Bt seeds after repeated field visits. It is worth noting that farmer knowledge about Bt seeds in

Edaggrineelu is no better than that seen in the GM farmers sample. The farmer claimed to plant non-Bt and proudly showed me a seed package, labeled Dr. Brent Bt Cotton. When I pointed out that this was a Bt seed, she told me, “Bt, non-Bt – you can read and I can’t, you tell me”. PANTA had not provided her with seeds that year and in the absence of their advice she went with a shop suggestion. The whole village, she says, does this when they don’t get seeds from PANTA. Repeating an erroneous but oft-spoken conception that Bt had some kind of poison in it that would harm the earth Bua Rajanna fell into interesting double speak: “It’s a chemical and we shouldn't keep it, but it makes the cotton grow well. It'll poison you if you touch it every day even if the production is more. You have to rotate with Bt as it poisons the field: if goats eat it they lose their hair and the same thing happens to the soil.” “But you just said you put it in your own fields,” I protested. “I was late getting the seed,” he explained, saying that he was planting it without telling PANTA. “Okay,” I said, “I won't tell either,” and he grinned sheepishly.

The deference to PANTA extends to the people with strong connections, but some speak out against them - Anjamma who lives next to Edaggrineelu’s champion show farmer, says that PANTA promised many great things but then is merciless when it comes to repaying loans. They were led to believe (although told is too strong) that they would not have to pay loans back and that the infrastructure was a gift, but that turns out to be untrue. This was a case of not looking a gift horse in the mouth. Drying rice seed on her front patio she began to criticize PANTA, saying that she has taken cow and pipe loans that were supposed to be lower interest or, better yet, never repaid. To her disappointment, she's being hounded by PANTA and despite spending her time talking with people like me and going to Delhi to talk about how her life has changed, she hasn't seen anything from them. “Even worse,” she continues, “the equipment they give comes from the government and when you don't pay them back you have both people asking you. It's all hard work, we don't see anything substantive from them." What about the training, I ask? "We already knew about almost all of that, what training did they teach us?" These frustrations simmer just under the surface, especially when farmers feel that their time and energy is being wasted.

Conventional farmers in the Warangal district were happy to take free advice from the consulting program E-Digu, and to declare the program a success. E-Digu indicated that they had saved farmers money, improved their scientific understanding of agriculture, and helped to bring technology from high-tech "Cyberabad" to the impoverished agrarian countryside of the Telangana region (Uday Kiran et al. 2010; Stone 2011b). Frustrated with what they saw as an ineffective extension service, computer scientists at the International Institute of Information Technology (IIIT) in Hyderabad sought to provide a better service whereby each farmer could pay to receive knowledge about their specific problems regularly through the growing season. As founder Dr. PK Rao explains, his goal was:

> to provide advice to every community in time how to reach the farm. The advice should be regular once again, because we feel that the next week's advice should be based on last week's advice. We should help the farmer [such that] the farmer doesn't even ask the question. That is very important in the Indian context – nobody will ask the question…[Government call centers] are unable to reach even 10% of the farmers, and nobody is asking questions. They don't know what to ask…most of the answers [the call center gives] are directions. 'I need fertilizers', 'okay go to this place and that place, those are pesticides shops'...Because society is not developed. Officially this is 50% illiteracy. The farmers are those who are illiterate, who have not studied at my age. So at my age, what happened was that people have not gone to school. Those are normal farmers…Again, you are reaching only elite farmers, not poor farmers. And we have [Scheduled Caste (SC)], ST, Lambadi farmers, I think you know. Knowledge is not reaching them.

In our interview, Rao emphasizes that his program fills a gap in farmer knowledge, one unfilled by lackluster government programs. Reaching thousands of farmers and winning numerous accolades, the project has shifted from a very personalized approach where individual farmers interact with scientists remotely to a more manageable and scalable approach where farmers solicit scientists one on one in local villages and pay for that service. In its current form, E-Digu gives generalized advice to a single village via community signs. This is ironic as their original impetus was to be farmer driven rather than top down and generalized. “We achieved the target”, says Reddy, and so “it must be replaced now.” The reason it must be replaced, to his perspective, is in part because “the farmer is overconfident” in his own knowledge and experience – in recent years only educated farmers who know best go for E-Digu. When they switched from free advice to a pay system in 2008, official farmer enrollment in the program dropped from more than 7000 to just above 1000; the staff dropped from 80 to six workers including only one full time field worker; the actual extension work has gone from individual consultations to a notice board that informs farmers about general agricultural problems. The same project that won Rao’s team awards and media attention had essentially collapsed due to a lack of farmer interest in the absence of free advice.

Village coordinator Raji recalls that the current version of E-Digu was first tested in 2007 in the village where PK Rao had been born, serving 300 paying farmer customers. But after five years Raji concluded that the constituents had learned “too much”, and no one was interested in paying to hear things that they already knew. Last year, only ten people asked for forty discrete solutions, totaling Rs 2000 at Rs fifty a pop. To put this in perspective, Raji’s salary is set at Rs 4000 per month plus Rs 1000 for petrol expenses, meaning that the project last year incurred a net loss of Rs 43,000 during his nine month stint. Why, I asked, did the farmers stop paying? As PK Rao recalled:

> In the first year [of large scale payment plans] 200 farmers paid. The second year it came down to 100. The third year it came down to thirty or forty per village. That means thirty or forty farmers will pay. Then I called the farmers, these SC, ST poor

> farmers, I said I am closing the system. So they said, why are you closing? Because you are not paying! You are not paying and government is not providing [funds to cover the balance]. No sir, we are following your advice. Everybody in the village is following your advice. How? How are you following? We are copying their advice. Those thirty farmers who are paying, we are copying [from them].
>
> Andrew: But that's a problem for the whole E-Digu system. Because you're saying every farm has distinct problems, so if they're just copying within the village it doesn't solve [those problems].
>
> P: Yeah, every farm is having distinct problem, but my results show that some farms are facing the same problem. Again, it's the anthropological problem. Basically you have perception. Everything is perception. What do you perceive? [The farmers] don't perceive the reality.

Farmers were happy to accept the lessons and profess their gratitude to the E-Digu team during an initial burst of didactic learning as long as E-Digu provided assistance without strings attached. However, as soon as this learning became expensive and their perceived rewards diminished, farmers did what they would do otherwise as evidenced by the seed-buying fads: they learned from their neighbors. Reddy claims that the farmers didn't perceive the reality of E-Digu's continued value, but it is more likely that his interventions were simply overrun by the cheaper and equally reliable social learning.

Taking Transformation Seriously

The characterization of transformation as a performance is not to suggest that it is insincere lip service. Roles must be learned and practiced, and some farmers, such as the show farmers, are much better performers than others. As illustrated by farmers in various intervention programs professing their prior ignorance of field management and business, Escobar (2011) and Agrawal (2005) are correct to note that people adjust the way in which they talk about themselves and their work to align with the incentives and new knowledge of experts when encountering development. To whatever extent that this performance breaks down under ethnographic scrutiny, farmers must learn to take advantage of the organic program, seed shop, extension office, or call center just as they process environmentally learned information about seed choices from their own fields and socially learned information from the fields of their neighbors. Farmers have learned that professing transformation is the first step in a positive feedback loop: perform transformation, generate a response from the intervention program or media, attract visitors with fame and buying power, secure future assistance in the form of consultation, loans, or farm equipment, profess to be even more transformed. This transformative sentiment is strategic and performative as it allows farmers to perform the roles expected of them by outside experts or consumers and required of them if they wish to reap the benefits of NGO, corporate, or scientific institutions. Farmers are rewarded for performing this ignorance and as such it becomes part of their learning process in a socially embedded agriculture.

I use performance here not to imply that farmers present a false image of themselves to others or pay mere lip service to the interventions in question. If organic farmers were only humoring the intentions of the program directors, the Ranaguda and Edaggrineelu farmers who switch to GM cotton seeds would not be so unmoored from their seed knowledge base. After years of learning to take seeds from the NGO and evaluating only differences between the two to three varieties that the program provides, farmers are left with no information to draw on except for the advice of callous shop owners. With narratives of transformation and the rewards of performing it to visitors removed, farmers are left to perform deference to experts in the shop.

This performance is inextricably linked to the learning process. Learning to perform roles in this environment rests on the reward structure of the particular program – how farmers learn to earn benefits by working with the system – which becomes just as important a knowledge feedback system as learning to manage one's field or copy one's neighbors. However, if farmers leave an organic program or find that the promised equipment, market access, news coverage, or local prestige fails to arrive, they are left with an even less reliable knowledge base than the previously described deskilled GM cotton farmers. Having learned to rely on the development scheme for resources and management, such farmers are totally dependent on shops or neighbors, in part because they have no first-hand knowledge to draw on.

Following the work of Erving Goffman (1959; 1956), I use performance here as a metaphor to describe how farmers have learned to portray themselves in this heavily didactic environment. The spread and learning curves of technology have a well-established "prestige bias" (Boyd and Richerson 1988; Henrich 2001; Rogers 2003), where farmers adopt technology in order to emulate socially important people. Goffman's theory of performance can complicate this by showing how farmers act in the face of active instructions.

Goffman is useful here in part because his emphasis is not on the individual, which would be farmers in interventions, so much as the interaction between the individual and the audience, which would include the intervention teachers and other farmers in this example. Viewing the self as a constructed projection allows us to account for the deference required when farmers talk about their knowledge (Goffman 1956), which manifests here as the socially expected transformation that must be performed if farmers want to stay on good terms with the program. Goffman specifically referred to this as a front, a performance given for the benefit of others to achieve specific social or material goals. When an organic program gives farmers seeds or subsidizes certain kinds of management, many farmers feel that it is more important to learn how to continue working with the intervention than to learn which method or seed is best. Such questions are irrelevant when the production risks are essentially underwritten by the program.

However, by learning to perform, a lucky few farmers can find themselves speaking to crowds of politicians and movie stars in Delhi or demonstrating their methods to news teams. By learning to present the right kind of self, a transformed, scientific, business-savvy self, farmers can secure both economic rewards and social recognition.

While meeting farmers involved with Prakruti, I asked Bhima, a former employee of the program, why he thought the villagers in one hamlet would stick with the program so enthusiastically while villagers less than a kilometer away in Ranaguda would reject it. He confirmed my own suspicions: Ataram Tulanna, a paid show farmer and field officer originally from the village. The presence of a paid educated and zealous field staff in the village, especially one who is blood relative of the other villagers, helps to keep people engaged with the program. Field office visits are infrequent and more superficial where the staff don't live and where the farmers aren't as invested to begin with. Former Ranaguda organic coordinator Jangu's zeal and bachelor’s degree in science is enough to convince his neighbor Krishna to plant organic seeds, but that sway does not extend to the rest of the village. Not only is his compound half a kilometer away from the village, he is less directly related to his fellow villagers. Lackluster support from Prakruti led even him to plant some Bt cotton in 2014 when he ran out of non-GM seeds.

Performance is thus highly dependent on the social and economic circumstances, namely the rewards that complicate social emulation or environmental learning. That is, the role that farmers play depends on the stage they are given: in the presence of economic or material rewards, as well as the added social recognition and sense of celebrity that comes from being regularly interviewed and photographed with visitors, farmers learn to perform and even embody the sense of transformation. This sentiment is then documented by visiting officials and researchers eager to show that their technology is not just improving farms but improving lives. But in the absence of reliable and deliverable rewards, or in the absence of consistent and trusted oversight, the transformation of the intervention falls aside in favor of the ways that farmers learn from each other. According to a study that purported to document the "emic perception of change in people's livelihoods" (Mancini, Van Bruggen, and Jiggins 2007:110) , Srigonda farmers who learned integrated pest management methods as part of an intervention to lower pesticide costs reported "an increased ability and confidence in choosing their management practices on the basis of field observations, resulting in cash savings and higher yields" (Mancini, Van Bruggen, and Jiggins 2007:106). While the farmers doubtlessly performed this transformative sentiment while working with the field school instructors, by 2012 IPM methods had largely been abandoned, in the words of one farmer, because "Bt came, and it gives the same benefit [of lower pesticide use] with less work."

Yet the story does not end there – in 2011, eight years after the initial training, agricultural scientist Umesh Reddy became involved with the same village and offered many of the same IPM suggestions to farmers. Unlike the previous short-term interventions, Reddy stayed and worked to build a farmer's cooperative in the village. As illustrated by the difference between the Prakruti organic villages who stayed with and left the program, long-term dedication and oversight allows farmers to learn they can successfully respond to didactic instruction. The absence of these rewards and oversight leads farmers to abandon the identity they perform as part of that intervention.

This chapter has argued that participants in didactic environments learn to embody a kind of transformative sentiment that is contingent on the reliability of social and material benefits, as well as the dedication or personal investment of the program directors. In performing this transformed sentiment, farmers learn not only agricultural methodology but how to cultivate a kind of celebrity that maintains the flow of social and economic resources in tandem with the intervention program. Building on Escobar, Agrawal, and others' study of the way in which farmers reorient themselves to think of their pre-intervention lives as ignorant and wasteful, I argue that this transformation is meaningful insofar as farmers can learn to work the system.

Chapter 10: Conclusions and Implications

Rooted in the theory of political ecology, this dissertation has examined how two legally exclusive agricultural regimes have impacted social, economic, and environmental life in rural Telangana. In addition, I have explored the relationship between three different kinds of seeds and the social politics of knowledge that they encourage on farmers' fields. Despite their presumptions to providing universal development solutions to farmers in India and by extension in the Global South generally, seeds and farming regimes have been reworked in new and unexpected ways by farmer participants. My research builds on a large body of work investigating the unintended consequences of development as technology is integrated into new contexts. Postcolonial anthropology is built around unveiling the reimagining of technology and the ways in which people seek out new avenues for success within a changing set of rewards and constraints.

Anna Tsing (2005) has described the impact of capitalism at its margins as an awkward friction, giving rise to the myriad contradictions seen when technologies are confronted and reappropriated: the introduction of soap in Zimbabwe requiring new conceptions of hygiene and status (Burke 1996); fertilizers and pesticides reimagined in India as part of an Ayurvedic understanding of plant health (Vasavi 1999; Gupta 1998); the invocation of spirits when confronted with the cold working relationships of foreign-owned firms in Bolivia (Taussig 1983) or Malaysia (Ong 2010); and now the widespread breakdown in knowledge regarding seeds intended to improve environmental sustainability through decreased pesticide sprays (Stone, Flachs, and Diepenbrock 2014). GM and organic methods, like other technologies, must first be negotiated at the frontier of capitalism and made meaningful if they are to have staying power.

A history of agrocapitalism that sees the adoption of technology as inevitable might argue that high adoption rates of GM cotton prove GM seeds' inevitable success, or at least their inevitable integration into Telangana smallholder agriculture. This is a view of capitalism in line with the original marketing thrust of GM seeds, which assumed that farmers would not need to do anything differently to successfully grow cotton – simply "plant the seeds and water them regularly" (Thaindian News 2008). But this uncomplicated progression has never been true with Indian cotton capitalism, it is a misleading narrative of agricultural modernization in the United States (Fitzgerald 2003; Kloppenburg 2004), and an evidence-based progress narrative does not accurately describe Bt or organic cotton growers. Attempting to separate truth from fiction in a vast, poorly understood seed market, most farmers are unable to trial and assess new technology quickly enough to use their personal environmental feedback to make seed decisions. Since 2002, seeds have remained popular for an average of only three years (Stone, Flachs, and Diepenbrock 2014). Given that intimate local ecological knowledge has been shown to be crucial to sustainability, the GM seed market appears to be eroding, rather than building local efforts at sustainability. Any instability in the seed market, such as the 2012 scarcity, can drive farmers to go to extraordinary and harmful lengths to secure particular seed brands, which are abandoned the following year. As for organic seeds, farmers face much lower yields, justified largely by non-agricultural benefits of learning to perform for visitors and officials.

I have argued that organic and GM development are being made meaningful in ways unintended by organic and GM proponents. Tsing calls attention to such activity as inhabiting the margins of capitalism where new meanings of commodities are born. Intended as an uncomplicated agricultural intervention (just plant and water the seed), the GM seed has caused "anarchic" (Herring 2007) brand confusion and periodic lapses in knowledge wherein farmers scramble to buy specific seeds for one or two years, abandon them the next year, and then repeat the process the following year (Stone, Flachs, and Diepenbrock 2014). Friction appears when farmers jump from seed to seed, pro-poor technology benefits the wealthiest, and more marginal farmers throw up their hands to demand "whatever's popular" in the shop. Intended to teach farmers new methods, organic agriculture often teaches farmers how to benefit from foreign buyers willing to underwrite their costs. These ironies are the essence of Tsing's friction in the development process. Postcolonial anthropology embraces such ironies, ethnographically describing the ways in which global modernity becomes "resisted, reinvented, and reconfigured in different social and historical locations" (Gupta 1998:9). Even when the regulation or technology arrives unchanged from foreign planners, farmers create new paths toward success (or failing that, getting by) within the reward structure of these agricultural regimes. This adaptation becomes clearest when we focus on how farmers make seed decisions under the new constraints and opportunities afforded to them by GM and organic agriculture.

In this conclusion I will summarize the three key contributions of this dissertation. (1) Farming, especially show farming, is a particular kind of social performance contingent on the human, ecological, and institutional audiences that farmers have to deal with. As always, performance is contingent on the shifting calculus that weighs social and economic costs in the field. Performance can refer to working closely with a specific organization like the institutional organic show farmers, performing a kind of agricultural modernity by conforming to the popular seed choices of the year, or satisfying the needs of saved crops, but it is a crucial element in the farmer decision-making process. (2) Farmer knowledge is based around the daily practice of environmental, social, and didactic learning in the field. Over-relying on any particular kind of information can lead to unreliable knowledge, but the danger is clearest when farmers stray too far from their first-hand environmental knowledge base. (3) Finally, like the performances, farmer knowledge is contingent. The same farmers can improperly balance knowledge of one crop while maintaining a solid knowledge base with a different crop. The processes by which knowledge is created and adapted are complicated and layered, but they are ultimately functions of the commodities or technology used and the social conditions by which the audience evaluates the farmer. In the remaining space I will also give a nod to the insights that such anthropological study can have for agricultural development generally. While I am not qualified to offer substantive policy suggestions, I believe this research can help to clarify the means by which farmers are pursuing success under GM and organic agriculture. It is my hope that by taking seriously farmers' responses to the rewards and constraints of organic and GM cotton farming, we can implement solutions better tailored to farmers' needs.

Knowledge as a Particular Kind of Performance

The work I have reviewed here, particularly Paul Richards (1985; 1989; 1993), Robert Netting (1993), and Harold Brookfield (2001) on the nature of skill as well as Glenn Stone (2007) or Deborah Fitzgerald (1993) on the destabilizing of skill, emphasize the necessity of local troubleshooting. Richards likened skill to a musical jam session, noting that farmers must draw on a shared repertoire of knowledge and respond to a variety of unexpected stimuli. Netting and Brookfield similarly stress that farmers who manage more diverse agronomic or labor variables in their fields learn more about their work and are thus better positioned to pursue agriculture that is resilient to plant diseases and market fluctuations. Allowing corporate forces to control the production and spread of hybrid seeds, Stone and Fitzgerald have shown how farmers became deskilled in the face of un-trialable hybrid and later GM hybrid seed markets.

Knowledge in this sense is in the hands of the performer, cultivated and used (or not) through the daily practice of environmental and social learning (Stone 2016; Boyd and Richerson 1988)

As described at length by Habermas (Fultner 2011) the commodification of knowledge encourages deskilling by transforming the spread of knowledge and skill from a social relationship into a transaction of capital. In this bleak view, states and the capitalist system seek a monopoly on knowledge. However, this is by no means assured. Due to its social and environmental complexity, much of agricultural work still relies on particular kinds of local knowledge. Looking to an iterative tripartite learning, one key to maintaining knowledge is continued use. This is an Aristotelian conception of knowledge, which sees knowledge as a habit and a virtue. The act of learning is thus an act of practice – because the reward structures of learning with different crops and planting strategies discussed here incentivize or constrain that practice, they also incentivize and constrain knowledge, and by proxy, sustainability.

Once acquired, this knowledge persists, with fluidity, in communities and individuals where frequent practice is deemed to be a worthy use of time and energy. Scott (1988) and Freidberg (2004) call this practical, adaptable skillset that develops from long term practice and manifests as the indescribable *feeling* that a practice is correct, metis: the Greek concept of practiced knowledge, stemming from Aristotelian virtue which understood it as part of the path toward eudaimonia, the state of happiness and prosperity of a life in the pursuit of knowledge and excellence. Excellence in human activity, such as metis, is a form of practice, a "coherent and complex form of socially established cooperative human activity through which goods internal to that form of activity are realized in the course of trying to achieve those standards of excellence...with the result that human powers to achieve excellence...are systematically extended" (MacIntyre 2007:187). Weeding does not fit this criterion, as it is a discrete task not necessarily extending the human excellence of plant removal. Agriculture on the other hand is such a practice of complex activity that produces what we understand to be agricultural goods. Engaging in such a practice connects with others who do so in the past and present, especially those whose achievements resonate in the present and demand study. Institutions help to sustain practices and adaptable metis knowledge functions to prevent the corrupting power of institutions on creativity, access, and cooperation. When agriculture is denied these things, it ceases to be a practice and is better understood as a part of a practice, just as weeding is a part of agriculture. Working outside the Greek tradition, Berkes comes to a similar conclusion and juxtaposes "the native knowledge of the natural milieu firmly rooted in the reality of an accumulation of concrete, personal experiences, as opposed to book-learning" (Berkes 2012:15). In each instance one practices a form of knowledge honed by continuous unpredictable adaptation within a generalizable framework. This knowledge is illegible and uncommodifiable as it cannot be codified or culturally marked as a certain kind of thing (Kopytoff 1988). Rather it forms an element of an improvisatory script called upon when farmers perform the act of farming for themselves, visitors, and each other (Richards 1989; Vanclay and Enticott 2011).

By emphasizing interpersonal interactions (Goffman 1959; Goffman 1956) and environmental learning I call attention to the audiences of these performers, arguing that metis is cultivated through a socially reinforced process of performance – farmers improvise, but they also build or lose social capital when their performances are viewed by NGOs, neighbors, family members, scientists, even the environment itself. Show farmers may be the most dramatic example of farmers performing roles to a distinct audience, but local village hierarchies determine who can talk comfortably to whom and who shows deference to whom. By extension, these channels determine local information flows and the audiences who observe the performance of that knowledge. Saved rice seeds and garden vegetables or flowers planted in the fields grow or die as farmers manage climactic and pest variation. Farmers have a flexibility with these crops, because they can be eaten or saved and because they are less bound to a high yield imperative, that is not seen in cotton due to deskilling or underwritten costs. In both cases, skill or metis is determined by a commodity form as it interacts with different audiences. That is, because it relies on a daily practice filtered through the environment, local social hierarchy, and institutional rewards, knowledge is a function of farmer performers responding to audience feedback.

Tripartite Knowledge as a Balancing Act

I have argued that audience response is both a danger and an opportunity for farmer skill. In a social practice like agriculture, emulating neighbors or listening to didactic institutions offers a chance to succeed outside of one's own environmental experience. Opportunistic show farmers demonstrate how some people can take advantage of new knowledge and new resources, while the over-reliance on social learning is a strategy, albeit flawed, for navigating the confusing GM cotton seed market. But in all three seed case studies, the ability to build skill rested on the ability to practice environmental learning.

GM cotton farmers, adrift in the market and overloaded by seed choices have found some solace in herding behavior (Stone, Flachs, and Diepenbrock 2014) and state governance that makes their choices appear more straight forward. That they continue to attempt cotton seed trials shows that they would be capable of building agricultural skill in a less confusing and actively duplicitous marketplace. Similarly, the knowledge of organic cotton farmers is not particularly useful because they are given seeds and told how to plant them. In both cases farmers are not rewarded for practicing and building environmental knowledge. Rather, they learn to respond to didactic NGOs, the logic of the herds, and the vague influence of shops or *pedda* farmers. In rice cultivation, the tripartite balance is skewed toward daily practice, privileging environmental learning over didactic or social learning. Rice cultivation allows farmers to maintain more control over their knowledge and its use. Farmers can test the waters of hybrid or hybrid breeding rices that are more pure commodities while still growing a crop about which they know a great deal. In rice cultivation, the yield, taste, and market sale rewards are aligned with farmer knowledge, and farmers better understand the seed market. Cotton agriculture takes place in a market that privileges didactic and social learning, thus leaving farmers vulnerable to deskilling.

Ultimately, this interaction between audiences and farmer knowledge ensures that farmer performances are contingent. In one sense, they are contingent on the commodity involved because the particular demands of different kinds of cultivation lead farmers to interact with different actors and environments. In another sense, they are contingent on the ways in which farmers engage development initiatives and perceive the relative benefits of that relationship. The kinds of knowledge built in agriculture fall out of practice without a reward structure that incentivizes their practice. To call show farmer agriculture performative is not to disparage it. Indeed, the institutional rewards for performance ensure that their agriculture is quite sustainable – for as long as the program supports them. Lacking that institutional support, cotton and rice farmers perform within the constraints established by local social hierarchy, field conditions, markets, and their own established knowledge.

Implications for the Future of Farming

Ironically, these agricultural technologies are not particularly effective at achieving the development goals they set to achieve. Much to the frustration of technologically-inclined proponents, GM and organic cotton seeds are put forward in damaging ways. Through the late 1990s, Indian cotton farmers suffered a troubling rise in bollworm pests, pesticide use, debt, and suicide. Depending on disciplinary focus, these problems have been described as acute, with plant scientists and some economists pointing to crop failures (Qaim and Zilberman 2003; Qaim 2010; Vaidyanathan 2006), or chronic, with anthropologists and social historians looking to global systems of capital or power (Galab, Revathi, and Reddy 2009; Deshpande and Arora 2010; Stone 2011b). Although not necessarily new in India, and despite no clear link between suicide and agrarian distress (Plewis 2014), the crisis captured international headlines. Roitman (2013) has argued that a crisis may be thus named to shape a narrative for particular political and economic purposes. In India, agrarian crisis apolitically characterized as an overabundance of cotton pests and chemicals opened the door for two legally exclusive technological solutions: Genetically modified (GM) Bt cotton and organic cotton.

In spite of this, this technology has had decidedly mixed results in practice. The state prices cotton seeds far below what the market is willing to pay, leading seed companies to sell the same product under different names to increase market shares and leading seed brokers to capitalize on frequent seed shortages in areas where farmers have difficulty getting to local retailers. Similarly, if the purpose of organic cotton cultivation is to produce a viable alternative to GM cotton and the kind of agriculture it represents, then low organic yields and the small percentage of farmers growing organic cotton indicate that the technology is ineffective in practice.

When alternative agricultures, which included GM cotton in its early phases, adhere to an NGO model of quick implementation, quick study, and a quick narrative of success, it reinforces a socioeconomic pattern by which these projects have no staying power or long-term support. Like many such development schemes, GM cotton and organic cotton projects are in a sense anti-political. Although show farmers or *pedaa* farmers perform as role models for other farmers and for their intervention generally, the compounding effects of social and didactic learning obscure the social and material resources that underwrite their success. Yet despite learning more about how to use NGO resources or how to work with extension agents than about agriculture itself, their performance fulfills what James Ferguson (1994) has called the development objective: their performed transformation from ignorance to development engenders closer relationships with project directors and more successful production, thereby encouraging other villagers to join. Ignoring the roles of these intermediaries leads outsiders across the commodity chain, from visiting farmers to consumers who read media on ethical cotton, to see these few farmers as representative of agriculture or development generally. Their mediation comes to look like a simple consumer choice and their success a symbol of the inherent superiority of the intervention. Paradoxically, their work is anti-political even as it is built upon a negotiated set of social and material rewards.

If publicized, these misleading data can find their way into the scientific literature as well. One would expect studies with industry ties to support pro-GM findings and those with ties to anti-industry Non-government organizations (NGOs) to support anti-GM findings. Examining the studies and their publicity as texts, Pearson (2006) argues "that there are striking similarities in the narratives utilized by both Monsanto *and* [anti-GM NGO] DDS; both seek to deploy 'objective science' in their efforts to govern smallholder farmers, and both purport to represent transparently the views of farmers and their best interests" (Pearson 2006:307, emphasis in original). Both GM companies and NGOs release studies claiming that one production mode is more or less profitable, socially sustainable, productive, or ecological, claims that Stone (2002) deems hyperbolic all around. These narratives even help to shape public perceptions of peasant farmers. Pearson sees the activist narrative as one that holds peasants in low esteem while the Monsanto narrative is largely concerned with farmers' ability to maximize their own benefits with the superior seeds, deemed to be superior by farmers' enthusiastic adoption.

Finally, this study highlights the potential dangers of overzealous corporate involvement in seeds. Had GM cotton remained as a choice between the three varieties approved in 2002, this would likely be a very different dissertation. Rice hybrids are not as popular now as cotton hybrids were in the 1990s, and for a variety of reasons outlined in chapter six having to do with the environmental learning process, rice agriculture may be resistant to deskilling. However, cotton's experience as a GM commodity may foreshadow the spread of a highly commodified GM rice. If GM rice seeds spread in the same way that GM cotton seed spread, namely with an initial period of heavy marketing to influential farmers, an explosion of confusing and un-trialable seed brands, an unwillingness of local retailers to sell non-GM seeds, and the relegation of non-GM varieties to specialty markets dominated by didactic programs who must make farmer knowledge a secondary concern to marketing, then the rice seed would come to look very much like cotton seed commodities. This would be disastrous for the indigenous knowledge now associated with Indian rice cultivation.

This dissertation stresses the danger of seeking technological fixes for agricultural problems. In part, this is because the practice of sustainable agriculture on the farm, the global challenge of feeding or clothing the world, is a social, not technological, question. In part, this is also because the unintended consequences of a new technology can and do create avenues by which some actors in the system can reap benefits at the expense of others: GM seed companies capitalize on the desperation of farmers, organic show farmers engineer the benefits of production to their advantage, alternative agriculture programs earn funds based on false starts, and green consumers at the end of the production chain consume clothing based on contrived images.

But more simply, danger of technological fixes ignores the daily, social work of agriculture. Farmers do not make simple cost/benefit analyses when evaluating new technologies and options. Their evaluation of development is a complex and shifting calculation of social meaning, performance, economics, and personal preference. Only by understanding this complicated intersection can we begin to understand sustainable agriculture.

Works Cited

10TV Telugu News
2013 Farming Without Chemicals in Edaggrineelu Village Warangal. https://www.youtube.com/watch?v=yy1zm1Sg7cs&feature=youtube_gdata_player, accessed October 29, 2014.

Agrawal, Arun
2005 Environmentality: Technologies of Government and the Making of Subjects. Durham: Duke University Press.

Alcorn, Jans B., and Victor M. Toledo
2000 Resilient Resource Management in Mexico's Forest Ecosystems: The Contribution of Property Rights. *In* Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience. Fikret Berkes, Carl Folke, and Johan Colding, eds. Cambridge University Press.

Appadurai, Arjun
1988 Introduction: Commodities and the Politics of Value. *In* The Social Life of Things: Commodities in Cultural Perspective. Arjun Appadurai, ed. Pp. 3–63. New York: Cambridge University Press.
1996 Modernity at Large: Cultural Dimensions of Globalization. Public Worlds, v. 1. Minneapolis, Minn: University of Minnesota Press.

Bagla, Pallava, and Richard Stone
2012 India's Scholar-Prime Minister Aims for Inclusive Development. Science 335(6071): 907–908.

Barlett, Peggy F
1989 Industrial Agriculture. *In* Economic Anthropology. Stuart Plattner, ed. Pp. 253–291. New York: Stanford University Press.

Basu, A.K., and R.S. Paroda
1995 Hybrid Cotton in India: A Success Story. 1995/1. Bangkok: Asia-Pacific Association of Agricultural Research Institutions.

Beckert, Sven
2014 Empire of Cotton: A Global History. New York: Knopf.

Benson, Peter
2012 Tobacco Capitalism: Growers, Migrant Workers, and the Changing Face of a Global Industry. Princeton: Princeton University Press.

Benson, Peter, and Edward F. Fischer
2007 Broccoli and Desire. Antipode 39(5): 800–820.

Berkes, Fikret
2012 Sacred Ecology. 3rd ed. New York: Routledge.

Bikhchandani, Sushil, David Hirshleifer, and Ivo Welch
1992 A Theory of Fads, Fashion, Custom, and Cultural Change as Informational Cascades. Journal of Political Economy 100(5): 992–1026.
1998 Learning from the Behavior of Others: Conformity, Fads, and Informational Cascades. The Journal of Economic Perspectives 12(3): 151–170.

Blaikie, Piers M.
1985 The Political Economy of Soil Erosion in Developing Countries. Longman Development Studies. New York: Longman.

Bourdieu, Pierre
2010 The Forms of Capital (1986). *In* Cultural Theory: An Anthology. Imre Szeman and Timothy Kaposy, eds. John Wiley & Sons.

Boyd, Robert, and Peter J. Richerson
1988 Culture and the Evolutionary Process. Chicago: University of Chicago Press.

Boyd, Robert, Peter J. Richerson, and Joseph Henrich
2011 The Cultural Niche: Why Social Learning Is Essential for Human Adaptation. Proceedings of the National Academy of Sciences 108(Supplement 2): 10918–10925.

Bradburn, Christopher
2014 Thousands of Plant Beeders: Women Conserving in Situ Crop Genetic Resources. Master's Thesis in Agricultural Science/Agroecology, Swedish University of Agricultural Sciences.

Braun, Arnoud, and Deborah Duveskog
2008 The Farmer Field School Approach – History, Global Assessment and Success Stories: Background Paper for the IFAD Rural Poverty Report 2011. Background Paper. IFAD Rural Poverty Report. IFAD.

Braverman, Harry
1998 Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century. Aniversary. New York: Monthly Review Press.

Brookfield, Harold C.
2001 Exploring Agrodiversity. New York: Columbia University Press.

Brubaker, Curt L., F.M. Bourland, and Jonathan F. Wendel
1999 The Origin and Domestication of Cotton. *In* Cotton: Origin, History, Technology, and Production. C. Wayne Smith and J. Tom Cothren, eds. Pp. 3–31. John Wiley & Sons.

Burke, Timothy
1996 Lifebuoy Men, Lux Women: Commodification, Consumption, and Cleanliness in Modern Zimbabwe. Durham: Duke University Press.

Charles, Daniel
2001 Lords of the Harvest: Biotech, Big Money, and the Future of Food. New York: Basic Books.

Chaudhuri, K.N.
1985 Trade and Civilisation in the Indian Ocean: An Economic History from the Rise of Islam to 1750. New York: Cambridge University Press.

Chernev, Alexander, Ulf Böckenholt, and Joseph Goodman
2015 Choice Overload: A Conceptual Review and Meta-Analysis. Journal of Consumer Psychology 25(2): 333–358.

Chetna Organic
2013 About Chetna Organic. http://www.chetnaorganic.org.in/about-us, accessed April 9, 2013.

Chua, Jasmin Malik
2010 H&M, Other Brands Guilty of "Organic Cotton Fraud"? Ecouterre, January 25. http://www.ecouterre.com/hm-other-brands-guilty-of-organic-cotton-fraud/, accessed April 5, 2012.

Conford, Philip
2011 The Development of the Organic Network: Linking People and Themes, 1945-95. Edinburgh: Floris Books.

Conklin, Harold C.
1961 The Study of Shifting Cultivation. Current Anthropology 2(1): 27–61.

Conley, Timothy G., and Christopher R. Udry
2010 Learning about a New Technology: Pineapple in Ghana. The American Economic Review 100(1): 35–69.

da Costa, Anna
2012 Organic Farming Promises to Yield a Sustainable Future for India's Rural Poor. The

Guardian, March 15. http://www.guardian.co.uk/global-development/poverty-matters/2012/mar/15/organic-farming-india-rural-poor, accessed April 2, 2012.

Cotton Corporation of India Ltd.
2011 Statistics - Page 5: The Cotton Corporation of India Ltd. Statistics - Page 5: The Cotton Corporation of India Ltd. http://cotcorp.gov.in/statistics.aspx?pageid=5#area1, accessed January 15, 2014.
2013 Cotton Corporation of India Annual Report 2012-2013. Annual Report, 43. Mumbai: Cotton Corporation of India Ltd.
2014 44th Annual Report 2013-2014. Annual Report, 44. Mumbai: Cotton Corporation of India Ltd.

Crost, Benjamin, Bhavani Shankar, Richard Bennett, and Stephen Morse
2007 Bias from Farmer Self-Selection in Genetically Modified Crop Productivity Estimates: Evidence from Indian Data. Journal of Agricultural Economics 58(1): 24–36.

Cullather, Nick
2013 The Hungry World: America's Cold War Battle against Poverty in Asia. Reprint edition. Cambridge: Harvard University Press.

Department of Commerce
2005 National Programme for Organic Production. New Delhi: Ministry of Commerce and Industry.

Deshpande, R.S., and Saroj Arora
2010 Agrarian Crisis and Farmer Suicides. New Delhi: Sage. https://books-google-com.libproxy.wustl.edu/books/about/Agrarian_Crisis_and_Farmer_Suicides.html?id=svyHAwAAQBAJ, accessed June 16, 2015.

Deshpande, Vivek
2010 Fraud Charges Cloud Indian Rise in Organic Cotton Production. The Indian Express, February 7. http://www.indianexpress.com/news/fraud-charges-cloud-indian-rise-in-organic-cotton-production/576678/0, accessed April 5, 2012.

Desmond, Elaine
2013 The Legitimation of Risk and Democracy: A Case Study of Bt Cotton in Andhra Pradesh, India. Doctoral Dissertation, University College Cork. https://cora.ucc.ie/handle/10468/1688, accessed November 4, 2014.

Dillehay, Tom D., Jack Rossen, Thomas C. Andres, and David E. Williams
2007 Preceramic Adoption of Peanut, Squash, and Cotton in Northern Peru. Science 316(5833): 1890–1893.

Dove, Michael R.
2011 The Banana Tree at the Gate: A History of Marginal Peoples and Global Markets in Borneo. Yale Agrarian Studies Series. New Haven [Conn.]: Yale University Press.

Dube, Saurabh, and Anand Pandian, eds.
2011 *In* Handbook of Modernity in South Asia: Modern Makeovers. 1st ed. Pp. 157–169. Oxford India Handbooks. New Delhi: Oxford University Press.

Duveskog, Deborah, Esbern Friss-Hansen, and Edward W Taylor
2011 Farmer Field Schools in Rural Kenya: A Transformative Learning Experience. Journal of Development Studies 47(10): 1529–1544.

Ehrlich, Paul R.
1971 The Population Bomb. Rev. ed. New York: Ballantine Books.

Engelman, Robert
2011 What a Population of 7 Billion People Means for the Planet. The Guardian. http://www.guardian.co.uk/environment/2011/jul/18/population-7-billion-planet, accessed September 7, 2012.

Eng, James
2011 Seven Big Problems for 7 Billion People. Msnbc.com. http://www.msnbc.msn.com/id/44990504/ns/us_news-life/t/seven-big-problems-billion-people/, accessed September 7, 2012.

Escobar, Arturo
2011 Encountering Development: The Making and Unmaking of the Third World. 2012 ed. Princeton, N.J. ; Woodstock: Princeton University Press.

Express TV
2014a Organic Cultivation in Edaggrineelu Village of Warangal District. https://www.youtube.com/watch?v=IXe0twwkt8s&feature=youtube_gdata_player, accessed October 29, 2014.
2014b Selection of Quality Seeds for Vegetation - Palleku Podamu. https://www.youtube.com/watch?v=W06ingqSSsQ&feature=youtube_gdata_player, accessed October 29, 2014.

Eyhorn, Frank
2007 Organic Farming for Sustainable Livelihoods in Developing Countries?: The Case of Cotton in India. vdf Hochschulverlag AG.

Eyhorn, Frank, Mahesh Ramakrishnan, and Paul Mäder
2007 The Viability of Cotton-Based Organic Farming Systems in India. International Journal of Agricultural Sustainability 5(1): 25–38.

Federal Trade Commission
2014 Threading Your Way Through the Labeling Requirements Under the Textile and Wool Acts. Washington DC: Federal Trade Commission.

Ferguson, James
1994 The Anti-Politics Machine: "Development," Depoliticization and Bureaucratic Power in Lesotho. Minneapolis, Minn: University of Minnesota Press.

Fitzgerald, Deborah
1993 Farmers Deskilled: Hybrid Corn and Farmers' Work. Technology and Culture 34(2): 324–343.
2003 Every Farm a Factory: The Industrial Ideal in American Agriculture. New Haven: Yale University Press.

Flachs, Andrew
2015 Persistent Agrobiodiversity on Genetically Modified Cotton Farms in Telangana, India. Journal of Ethnobiology 35(2): 406–426.

Forster, Dionys, Christian Andres, Rajeev Verma, et al.
2013 Yield and Economic Performance of Organic and Conventional Cotton-Based Farming Systems – Results from a Field Trial in India. PLoS ONE 8(12): e81039.

Franz, Martin, and Markus Hassler
2010 The Value of Commodity Biographies: Integrating Tribal Farmers in India into a Global Organic Agro-Food Network. Area 42(1): 25–34.

Fultner, Barbara, ed.
2011 Jürgen Habermas: Key Concepts. Key Concepts. Durham, England: Acumen.

Galab, S., E. Revathi, and P. Prudhvikar Reddy
2009 Farmers' Suicides and Unfolding Agrarian Crisis in Andhra Pradesh. *In* Agrarian Crisis in India. D. Narasimha Reddy and Srijit Mishra, eds. New Delhi ; New York: Oxford University Press.

GEAC
2012 Yearwise List of Commercially Released Varieties of Bt Cotton Hybrids by GEAC (Year 2002 - Up to May 2012). Standing Committee Report. Delhi: Department of Biotechnology of India.

Godtland, Erin M., Elisabeth Sadoulet, Alain de Janvry, Rinku Murgai, and Oscar Ortiz
2004 The Impact of Farmer Field Schools on Knowledge and Productivity: A Study of Potato Farmers in the Peruvian Andes. Economic Development and Cultural Change 53(1): 63–92.

Goffman, Erving
1956 The Nature of Deference and Demeanor. American Anthropologist 58(3): 473–502.
1959 The Presentation of Self in Everyday Life. 1 edition. New York N.Y.: Anchor.

Goodman, David, Bernardo Sorj, and John Wilkinson

1987 From Farming to Biotechnology: A Theory of Agro-Industrial Development. Oxford: Basil Blackwell.

Graß, Therese
2013 H&M – a Role Model for Organic Cotton Use in Textile Processing? Journal of European Management & Public Affairs Studies 1(1): 23–26.

Griliches, Zvi
1957 Hybrid Corn: An Exploration in the Economics of Technological Change. Econometrica 25(4): 501–522.
1980 Hybrid Corn Revisited: A Reply. Econometrica 48(6): 1463–1465.

Gruère, Guillaume, and Debdatta Sengupta
2011 Bt Cotton and Farmer Suicides in India: An Evidence-Based Assessment. Journal of Development Studies 47(2): 316–337.

Gruère, Guillaume, and Yan Sun
2012 Measuring the Contribution of Bt Cotton Adoption to India's Cotton Yields Leap. IFPRI discussion paper, 01170. Environment and Production Technology Division. IFPRI.

Guha, Ramachandra
2008 India after Gandhi: The History of the World's Largest Democracy. [India]: Picador.

Guha, Smit
2007 Genetic Change and Colonial Cotton Improvement in Nineteenth and Twentieth Century India. *In* Situating Environmental History. Ranjan Chakrabarti, ed. New Delhi: Manohar.

Gupta, Akhil
1998 Postcolonial Developments: Agriculture in the Making of Modern India. Durham: Duke University Press Books.

Guthman, Julie
2004 Agrarian Dreams: The Paradox of Organic Farming in California. Berkeley: University of California Press.
2009 Unveiling the Unveiling: Commodity Chains, Commodity Fetishism, and Ethical Food Labels. *In* Frontiers of Commodity Chain Research. Jennifer Bair, ed. Pp. 190–206. Stanford, Calif: Stanford University Press.

Heinemann, Jack
2012 Suggestions on How to Apply International Safety Testing Guidelines for Genetically Modified Organisms. Christchurch, New Zealand: Centre for Integrated Research in Biosafety.

Henrich, Joseph
2001 Cultural Transmission and the Diffusion of Innovations: Adoption Dynamics Indicate That Biased Cultural Transmission Is the Predominate Force in Behavioral Change. American Anthropologist 103(4): 992–1013.

Herring, Ronald J.
2007 Stealth Seeds: Bioproperty, Biosafety, Biopolitics. Journal of Development Studies 43(1): 130–157.
2013 Reconstructing Facts with Bt Cotton: Why Scepticism Fails. Economic and Political Weekly 48(33): 63–66.

Herring, Ronald J., and N Chandrasekhara Rao
2012 On the “Failure of Bt Cotton”: Analysing a Decade of Experience. Economic and Political Weekly 47(18): 45–53.

Hippel, Eric von
1994 “Sticky Information” and the Locus of Problem Solving: Implications for Innovation. Management Science 40(4): 429–439.

Huang, Jikun, Ruifa Hu, Carl Pray, Fangbin Qiao, and Scott Rozelle
2003 Biotechnology as an Alternative to Chemical Pesticides: A Case Study of Bt Cotton in China. Agricultural Economics 29(1): 55–67.

Illge, Lydia, and Lutz Preuss
2012 Strategies for Sustainable Cotton: Comparing Niche with Mainstream Markets. Corporate Social Responsibility and Environmental Management 19(2): 102–113.

Ingold, Tim
2011 The Perception of the Environment: Essays on Livelihood, Dwelling & Skill. 2nd edition. New York: Taylor & Francis Group.

Iyengar, Sheena S., Gur Huberman, and Wei Jang
2004 How Much Choice Is Too Much? Contributions to 401(k) Retirement Plans. *In* Pension Design and Stricutre: New Lessons from Behavior Finance. Olivia S. Mitchell and Steve Utkus, eds. Pp. 83–95. Oxford: Oxford University Press.

Iyengar, Sheena S., and Mark R. Lepper
2000 When Choice Is Demotivating: Can One Desire Too Much of a Good Thing? Journal of Personality and Social Psychology 79(6): 995–1006.

James, Clive
2010 Global Status of Commercialized Biotech/GM Crops: 2009. ISAAA Brief, 41-2009: Slides & Tables.

James, Erica Caple
2010 Democratic Insecurities: Violence, Trauma, and Intervention in Haiti. California Series in Public Anthropology, 22. Berkeley: University of California Press.

Jasanoff, Sheila

2005 Designs on Nature: Science and Democracy in Europe and the United States. Princeton, N.J: Princeton University Press.

Jayaraman, K. S.
2001 Illegal Bt Cotton in India Haunts Regulators. Nature Biotechnology 19(12): 1090–1090.

Johnson, Walter
2013 River of Dark Dreams: Slavery and Empire in the Cotton Kingdom. First Edition edition. Belknap Press.

Jonathan, P. Samuel
2010 Two New Rice Varieties Developed. The Hindu, May 25. http://www.thehindu.com/todays-paper/tp-national/tp-andhrapradesh/two-new-rice-varieties-developed/article773478.ece, accessed March 30, 2015.

Joshua, Anita, and B. Muralidhar Reddy
2014 15th Lok Sabha Holds Nerve, Passes Telangana Bill. The Hindu, February 18. http://www.thehindu.com/news/national/15th-lok-sabha-holds-nerve-passes-telangana-bill/article5702134.ece, accessed March 12, 2014.

Kathage, Jonas, and Matin Qaim
2012 Economic Impacts and Impact Dynamics of Bt (Bacillus Thuringiensis) Cotton in India. Proceedings of the National Academy of Sciences 109(29): 11652–11656.

Kloppenburg, Jack
2004 First the Seed: The Political Economy of Plant Biotechnology 1492-2000. Madison: University of Wisconsin Press.

Kolanu, Thilotham R, and Sunil Kumar
2003 Greening Agriculture in India: An Overview of Opportunities & Constraints. Food and Agriculture Organization of the United Nations. http://www.fao.org/DOCREP/ARTICLE/AGRIPPA/658_en00.htm#TopOfPage, accessed April 2, 2012.

Kopytoff, Igor
1988 The Cultural Biography of Things: Commoditization as Process. *In* The Social Life of Things: Commodities in Cultural Perspective. Arjun Appadurai, ed. Pp. 64–91. New York: Cambridge University Press.

Kothari, Uma
2005 Authority and Expertise: The Professionalisation of International Development and the Ordering of Dissent. Antipode 37(3). aph: 425–446.

Kouser, Shahzad, and Matin Qaim
2011 Impact of Bt Cotton on Pesticide Poisoning in Smallholder Agriculture: A Panel Data

Analysis. Ecological Economics 70(11). Special Section - Earth System Governance: Accountability and Legitimacy: 2105–2113.

Kranthi, KR
2012 Bt Cotton Q&A. Mumbai: Indian Society for Cotton Improvment.

Kristof, Nicholas
2009 If This Isn't Slavery, What Is? The New York Times, January 3. http://www.nytimes.com/2009/01/04/opinion/04kristof.html, accessed November 12, 2014.

Kudlu, Chithprabha, and Glenn Davis Stone
2013 The Trials of Genetically Modified Food: Bt Eggplant and Ayurvedic Medicine in India. Food, Culture, and Society 16(1): 21–42.

Kunzig, Robert
2011 Population 7 Billion. National Geographic: 32–63.

Kurmanath, K.V.
2013 Telangana Will Show Its Might in Cotton, Maize. The Hindu Business Line, August 2. http://www.thehindubusinessline.com/industry-and-economy/agri-biz/telangana-will-show-its-might-in-cotton-maize/article4982372.ece, accessed March 12, 2014.

Lalita, Ke, Kannabiran Vasantha, Rama S Melkote, et al.
1989 We Were Making History: Life Stories of Women in the Telangana People's Struggle. London ; Atlantic Highlands, N.J., USA: Zed Books. http://JE5QH2YG7P.search.serialssolutions.com/?V=1.0&L=JE5QH2YG7P&S=JCs&C=TC0000409755&T=marc, accessed October 27, 2012.

Lansing, John Stephen
1991 Priests and Programmers: Technologies of Power in the Engineered Landscape of Bali. Princeton, N.J: Princeton University Press.
2006 Perfect Order: Recognizing Complexity in Bali. Princeton Studies in Complexity. Princeton, N.J: Princeton University Press.

Latour, Bruno
1986 Laboratory Life: The Construction of Scientific Facts. Princeton, N.J: Princeton University Press.
2003 The Promises of Constructivism. *In* Chasing Technoscience: Matrix for Materiality. Don Ihde and Evan Selinger, eds. Pp. 27–46. Bloomington: Indiana University Press.
2010 On the Modern Cult of the Factish Gods. Durham [NC]; London: Duke University Press.

Leslie, Paul, and J. Terrence McCabe
2013 Response Diversity and Resilience in Social-Ecological Systems. Current Anthropology 54(2): 114–143.

Linssen, Rik, Luuk van Kempen, and Gerbert Kraaykamp

2010 Subjective Well-Being in Rural India: The Curse of Conspicuous Consumption. Social Indicators Research 101(1): 57–72.

Ludden, David
1999 An Agrarian History of South Asia. Cambridge University Press.

Magdoff, Fred, John Bellamy Foster, and Frederick H. Buttel, eds.
2000 Hungry for Profit: The Agribusiness Threat to Farmers, Food, and the Environment. New York: Monthly Review Press.

Makita, Rie
2012 Fair Trade and Organic Initiatives Confronted with Bt Cotton in Andhra Pradesh, India: A Paradox. Geoforum 43(6): 1232–1241.

Malthus, Thomas Robert
1976 An Essay on the Principle of Population. *In* An Essay on the Principle of Population: Text, Sources and Background, and Criticism Pp. 15–129. New York: W.W. Norton & Company Inc.

Mancini, Francesca, Aad J. Termorshuizen, Janice L.S. Jiggins, and Ariena H.C. van Bruggen
2008 Increasing the Environmental and Social Sustainability of Cotton Farming through Farmer Education in Andhra Pradesh, India. Agricultural Systems 96(1-3): 16–25.

Mancini, Francesca, Ariena H.c. Van Bruggen, and Janice L.s. Jiggins
2007 Evaluating Cotton Integrated Pest Management (IPM) Farmer Field School Outcomes Using the Sustainable Livelihoods Approach in India. Experimental Agriculture 43(01): 97–112.

Marks, Simon
2014 Somaly Mam: The Holy Saint (and Sinner) of Sex Trafficking. Newsweek, May 21. http://www.newsweek.com/2014/05/30/somaly-mam-holy-saint-and-sinner-sex-trafficking-251642.html, accessed November 12, 2014.

Martin, Gary J.
1995 Ethnobotany: A Methods Manual. Earthscan.

Mehta, B. H.
1984 Gonds of the Central Indian Highlands. New Delhi: Concept Publishing Company. http://books.google.com.libproxy.wustl.edu/books/about/Gonds_of_the_Central_Indian_Highlands.html?id=X2gpF5bsAjUC, accessed April 23, 2015.

Mezirow, Jack
2000 Learning as Transformation: Critical Perspectives on a Theory in Progress. The Jossey-Bass Higher and Adult Education Series. Jossey-Bass Publishers, 350 Sansome Way, San Francisco, CA 94104. Tel: 888-378-2537; Fax: 800-605-2665 (Toll Free); Web site: http://www.josseybass.com ($38.95). http://eric.ed.gov/?id=ED448301, accessed September 25, 2014.

Mines, Diane P.
2005 Fierce Gods: Inequality, Ritual, and the Politics of Dignity in a South Indian Village. Bloomington: Indiana University Press.

Misra, Savvy Soumya
2009 Riding High. Down To Earth: 21–28.

Mitra, Amit, and M. Somasekhar
2013 Textile Mills Will Suffer Once Telangana Turns Cotton Hub. The Hindu Business Line, August 18. http://www.thehindubusinessline.com/industry-and-economy/textile-mills-will-suffer-once-telangana-turns-cotton-hub/article5035378.ece, accessed March 12, 2014.

Mohan, Vishwa
2013 Sharad Pawar Bats for GM Crops in House, Holds up Bt Cotton as Success Story. The Times of India, August 28. http://timesofindia.indiatimes.com/india/Sharad-Pawar-bats-for-GM-crops-in-House-holds-up-Bt-cotton-as-success-story/articleshow/22109722.cms, accessed April 3, 2014.

Monsanto Company
2008 Farmer Suicides in India – Is There a Connection with Bt Cotton? http://www.monsanto.com/newsviews/Pages/india-farmer-suicides.aspx, accessed April 5, 2012.
2012 India Cotton Success. India Cotton Success. http://www.monsanto.com/improvingagriculture/pages/celebrating-bollgard-cotton-india.aspx, accessed September 25, 2014.

Munshi, Kaivan
2004 Social Learning in a Heterogeneous Population: Technology Diffusion in the Indian Green Revolution. Journal of Development Economics 73(1): 185–213.

Nabhan, Gary Paul, Amadeo M Rea, Karen L Reichhardt, Eric Mellink, and Charles F Hutchinson
1983 Papago (O'odham) Influences on Habitat and Biotic Diversity: Quitovac Oasis Ethnoecology. *In* Ethnobotany: A Reader. Paul E Minnis, ed. Pp. 41–64. Norman: University of Oklahoma Press.

Naik, B. Sarveswara
1983 Status and Role of Women in the Changing Banjara (Lambadi) Community of Andhra Pradesh. Indian Anthropologist 13(2): 17–26.

Naik, Dhanasing B.
2000 The Art and Literature of Banjara Lambanis: A Socio-Cultural Study. New Delhi: Abhinav Publications.

Narayanan, S
2005 Organic Farming in India: Relevance, Problems, and Constraints. Occasional Paper, 38.

Mumbai: Department of Economic Analysis and Research National Bank for Agriculture and Rural Development.

Netting, Robert McC
1993 Smallholders, Householders: Farm Families and the Ecology of Intensive, Sustainable Agriculture. Stanford: Stanford University Press.

Newell, Peter
2003 Biotech Firms, Biotech Politics: Negotiating GMOs in India. IDS Working Paper, 201. Brighton: Institute of Development Studies.

Ong, Aihwa
2010 Spirits of Resistance and Capitalist Discipline: Factorywomen in Malaysia. 2nd ed. Suny Series in the Anthropology of Work. Albany: State University of New York Press.

Oreskes, Naomi, and Erik M. M. Conway
2011 Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming. Reprint. New York: Bloomsbury Press.

Ortner, Sherry
1984 Theory in Anthropology since the Sixties. Comparative Studies in Society and History 26(1): 126–166.

Paarlberg, Robert L
2001 The Politics of Precaution: Genetically Modified Crops in Developing Countries. Baltimore: The Johns Hopkins University Press.

Pandian, Anand
2011 Ripening with the Earth: On Maturity and Modernity in South India. *In* Modern Makeovers: A Handbook of Modernity in South Asia. 1st edition. Saurabh Dube, ed. Pp. 157–169. New Delhi: Oxford University Press.

Panneerselvam, P., Niels Halberg, Mette Vaarst, and John Erik Hermansen
2012 Indian Farmers' Experience with and Perceptions of Organic Farming. Renewable Agriculture and Food Systems 27(02): 157–169.

Parsai, Gargi
2012 Protests Mark 10th Anniversary of Bt Cotton. The Hindu, March 27. http://www.thehindu.com/sci-tech/agriculture/article3248530.ece, accessed April 4, 2012.

Pearson, Mark
2006 "Science", Representation and Resistance: The Bt Cotton Debate in Andhra Pradesh, India. The Geographical Journal 172(4): 306–317.

Perkins, John H.

1997 Geopolitics and the Green Revolution: Wheat, Genes, and the Cold War. New York: Oxford University Press.

Piperno, Dolores R.
1998 The Origins of Agriculture in the Lowland Neotropics. San Diego: Academic Press.

Plewis, Ian
2014 Indian Farmer Suicides: Is GM Cotton to Blame? Significance 11(1): 14–18.

Pollan, Michael
2002 The Botany of Desire. New York: Random House.
2006 The Omnivore's Dilemma: A Natural History of Four Meals. New York: Penguin Group.

Prabu, M. J.
2013 Organic Cultivation: Learning from the Edaggrineelu Example. The Hindu, August 22. http://www.thehindu.com/sci-tech/agriculture/organic-cultivation-learning-from-the-enabavi-example/article5045359.ece, accessed January 7, 2014.

Prashanth, P., M. J. M. Reddy, and I. S. Rao
2013 Organic Cotton Farming in Andhra Pradesh - a Constraint Analysis. Journal of Cotton Research and Development 27(1). CABDirect2: 138–143.

Qaim, Matin
2003 Bt Cotton in India: Field Trial Results and Economic Projections. World Development 31(12): 2115–2127.
2009 The Economics of Genetically Modified Crops. Annual Review of Resource Economics 1(1): 665–694.
2010 Benefits of Genetically Modified Crops for the Poor: Household Income, Nutrition, and Health. New Biotechnology 27(5): 552–557.

Qaim, Matin, and David Zilberman
2003 Yield Effects of Genetically Modified Crops in Developing Countries. Science 299(5608): 900–902.

Quartz, Julia
2010 Creative Dissent with Technoscience in India: The Case of Non-Pesticidal Management (NPM) in Andra Pradesh. International Journal of Technology and Development Studies 1(1): 55–92.

Raghupati, Tarakarama Rao, and Jay Shankar Prasad
2009 Edaggrineelu - The Road Ahead in Agriculture. *In* The Poor and the Private Sector. Public Private Community Partnership: Cases Fom the FIeld. Shoba Ramachandran, ed. New Delhi: ACCESS Development SErvices.

Ram, M. Kodanda

2007 Movement for Telangana State: A Struggle for Autonomy. Economic and Political Weekly 42(2): 90–94.

Rao, A Srinivasa
2012 Acute Shortage of Bt Cotton Seeds in Andhra Pradesh. India Today. http://indiatoday.intoday.in/story/acute-shortage-of-bt-cotton-seeds-in-andhra-pradesh/1/202206.html, accessed September 13, 2012.

Reddy, B. Muralidhar
2014 Telangana to Come into Existence on June 2. The Hindu, March 5. http://www.thehindu.com/news/national/andhra-pradesh/telangana-to-come-into-existence-on-june-2/article5751092.ece, accessed March 12, 2014.

Richards, Paul
1985 Indigenous Agricultural Revolution: Ecology and Food Production in West Africa. Boulder: Westview Press.
1989 Agriculture as a Performance. *In* Farmer First: Farmer Innovation and Agricultural Research. Robert Chambers, Arnold Pacey, and Lori Ann Thrupp, eds. London: Intermediate Technology. http://books.google.com.libproxy.wustl.edu/books/about/Farmer_First.html?id=eA5xEALndC4C, accessed May 4, 2015.
1993 Cultivation: Knowledge or Performance? *In* An Anthropological Critique of Development: The Growth of Ignorance. Mark Hobart, ed. Pp. 61–78. New York: Routledge.

Richerson, Peter J., and Robert Boyd
2008 Not By Genes Alone: How Culture Transformed Human Evolution. University of Chicago Press.

Rieple, Alison, and Rajbir Singh
2010 A Value Chain Analysis of the Organic Cotton Industry: The Case of UK Retailers and Indian Suppliers. Ecological Economics 69(11). Special Section - Payments for Ecosystem Services: From Local to Global: 2292–2302.

Robbins, Paul
2004 Political Ecology: A Critical Introduction. Critical Introductions to Geography. Malden, MA: Blackwell Pub.

Rogers, Everett M.
2003 Diffusion of Innovations. 5th edition. New York: Free Press.

Roitman, Janet
2013 Anti-Crisis. Durham: Duke University Press Books.

Ross, Eric B
1998 The Malthus Factor: Poverty, Politics, and Population in Capitalist Development. New York: Zed Books.

Roy, Devparna, Ronald J. Herring, and Charles C. Geisler
2007 Naturalising Transgenics: Official Seeds, Loose Seeds and Risk in the Decision Matrix of Gujarati Cotton Farmers. Journal of Development Studies 43(1): 158–176.

Ryan, Bryce, and Neal C. Gross
1943 The Diffusion of Hybrid Seed Corn In Two Iowa Communities. Rural Sociology 8(1). sih: 15–24.

Sainath, P.
2013 Over 2,000 Fewer Farmers Every Day. The Hindu, May 2. http://www.thehindu.com/opinion/columns/sainath/over-2000-fewer-farmers-every-day/article4674190.ece, accessed March 17, 2014.

Scheibehenne, Benjamin, Rainer Greifeneder, and Peter M. Todd
2010 Can There Ever Be Too Many Options? A Meta-Analytic Review of Choice Overload. Journal of Consumer Research 37(3): 409–425.

Schmid, Otto
2007 Development of Standards for Organic Farming. *In* Organic Farming: An International History. William Lockeretz, ed. Pp. 152–174. Cambridge: CABI.

Schurman, Rachel, and William A. Munro
2010 Fighting for the Future of Food: Activists Versus Agribusiness in the Struggle Over Biotechnology. Minneapolis: University of Minnesota Press.

Scoones, Ian
2006 Science, Agriculture and the Politics of Policy: The Case of Biotechnology in India. New Delhi: Orient Blackswan.
2008 Mobilizing Against GM Crops in India, South Africa, and Brazil. Journal of Agrarian Change 8(2 and 3): 315–344.

Scott, James C.
1998 Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed. New Haven: Yale University Press.

Sengupta, Debdatta, Guillaume Gruère, and Purvi Mehta-Bhatt
2008 Bt Cotton and Farmer Suicides in India: Reviewing the Evidence. IFPRI discussion paper, 00808. International Food Policy Research Institute (IFPRI).

Shaffer, Christopher A, and Andrew Flachs
2014 GIS as a Tool for Spatial Modeling in TelanganaCotton Seed Fads. Presentation presented at the American Anthropological Association, Washington DC.

Shah, Esha

2005 Local and Global Elites Join Hands: Development and Diffusion of Bt Cotton Technology in Gujarat. Economic and Political Weekly 40(43): 4629–4639.

Shetty, P. K.
2004 Socio-Ecological Implications of Pesticide Use in India. Economic and Political Weekly 39(49): 5261–5267.

Shiva, Vandana
1993 The Violence of the Green Revolution: Third World Agriculture, Ecolgy, and Politics. 2nd edition. Atantic Highlands, NJ: Third World Network.
1997 Biopiracy: The Plunder of Nature and Knowledge. Boston: South End Press Collective.

Stoll, Steven
2002 Larding the Lean Earth: Soil and Society in Nineteenth Century America. New York: Hill and Wang.

Stone, Glenn Davis
2002 Both Sides Now: Fallacies in the Genetic-Modification Wars, Implications for Developing Countries, and Anthropological Perspectives. Current Anthropology 43(4): 611–630.
2007 Agricultural Deskilling and the Spread of Genetically Modified Cotton in Warangal. Current Anthropology 48(1): 67–103.
2011a Field versus Farm in Warangal: Bt Cotton, Higher Yields, and Larger Questions. World Development 39(3): 387–398.
2011b Contradictions in the Last Mile Suicide, Culture, and E-Agriculture in Rural India. Science, Technology & Human Values 36(6): 759–790.
2012 Constructing Facts: Bt Cotton Narratives in India. Economic and Political Weekly 47(38): 62–70.
2013 A Response to Herring and Rao. Economic and Political Weekly 48(33): 70–72.
2014 Theme Park Farming in Japan. Blog. Fieldquestions. http://fieldquestions.com/2014/06/05/theme-park-farming-in-japan/, accessed November 12, 2014.
2015 Biotechnology, Schismogenesis, and the Demise of Uncertainty. Journal of Law and Policy 47: 29–49.
2016 Towards a General Theory of Agricultural Knowledge Production: Environmental, Social, and Didactic Learning. Culture, Agriculture, Food and Environment 38(1): 5–17.

Stone, Glenn Davis, and Andrew Flachs
2014 The Problem with the Farmer's Voice. Agriculture and Human Values: 1–5.

Stone, Glenn Davis, Andrew Flachs, and Christine Diepenbrock
2014 Rhythms of the Herd: Long Term Dynamics in Seed Choice by Indian Farmers. Technology in Society 36(1): 26–38.

Sumberg, James E., and C. Okali
1997 Farmer's Experiments: Creating Local Knowledge. Boulder, Colorado: Lynne Rienner Publishers.

Taussig, Michael
1983 Devil and Commodity Fetishism in South America. Chapel Hill: University of N. Carolina Press.

Tepic, Merisha, Jacques H. Trienekens, Robert Hoste, and S.W.F. Omta
2012 The Influence of Networking and Absorptive Capacity on the Innovativeness of Farmers in the Dutch Pork Sector. International Food and Agribusiness Management Review 15(3): 1–34.

Textile Exchange
2013 Farm and Fiber Report 2011-2012. Annual Report. Published Online: Textile Exchange.

Thaindian News
2008 Genetic Engineering Can Help Solve Food Crisis: US Expert. Thaindian News. http://www.thaindian.com/newsportal/sci-tech/genetic-engineering-can-help-solve-food-crisis-us-expert_10077548.html, accessed March 5, 2014.

The Economic Times
2010 India Aims to Export $1 Bn Organic Products in Next 5 Yrs. The Economic Times. http://articles.economictimes.indiatimes.com/2010-05-15/news/27615711_1_organic-products-organic-cotton-organic-production, accessed April 3, 2012.
2012 Biotechnology Sector to Have More M&A Activity due to Fund Crunch: Report. The Economic Times. http://articles.economictimes.indiatimes.com/2012-02-15/news/31063294_1_biotechnology-sector-biotech-industry-fund-crunch, accessed April 4, 2012.

The Hindu
2007 Bt.cotton II Price Pegged at Rs. 750. The Hindu, May 5: 03.
2012 Fake Cotton Seed Seized, One Arrested. The Hindu. http://www.thehindu.com/todays-paper/tp-national/tp-andhrapradesh/article3507892.ece, accessed September 13, 2012.
2014 Timeline: Telangana. The Hindu, February 18. http://www.thehindu.com/news/national/timeline-telangana/article5702786.ece, accessed March 12, 2014.

The Hindu Business Line
2013 Production Dips Even as 90% Land Is under Bt Cotton Cultivation: Mahant. The Hindu Business Line, March 15. http://www.thehindubusinessline.com/industry-and-economy/agri-biz/production-dips-even-as-90-land-is-under-bt-cotton-cultivation-mahant/article4512380.ece, accessed February 25, 2014.
2014 Telangana, the 29th State, Is Real at Last. The Hindu Business Line, February 18. http://www.thehindubusinessline.com/news/politics/telangana-the-29th-state-is-real-at-last/article5703206.ece, accessed March 12, 2014.

The New Indian Express
2012 A Mayhem Called Mahyco Seed Shortage. The New Indian Express.

http://newindianexpress.com/states/andhra_pradesh/article550368.ece, accessed September 11, 2012.

Tripp, Robert
2006 Self-Sufficient Agriculture: Labour and Knowledge in Small-Scale Farming. Sterling: Routledge.

Tripp, Robert, and Suresh Pal
2000 Information and Agricultural Input Markets: Pearl Millet Seed in Rajasthan. Journal of International Development 12(1): 133–144.

Tsing, Anna Lowenhaupt
2005 Friction: An Ethnography of Global Connection. Princeton, N.J. ; Oxford: Princeton University Press.

Turner, Victor
1970 The Forest of Symbols: Aspects of Ndembu Ritual. Ithaca: Cornell University Press.
1980 Social Dramas and Stories about Them. Critical Inquiry 7(1): 141–168.

Uday Kiran, R., P. Krishna Reddy, M. Kumara Swamy, and G. Syamasundar Reddy
2010 Analysing Dynamics of Crop Problems by Applying Text Analysis Methods on Farm Advisory Data of eSagu. International Journal of Computational Science and Engineering 5(2): 154–164.

USDA Foreign Agricultural Service
2015 Cotton: World Markets and Trade. Tade Report. World Production, Markets, and Trade Reports. Washington DC: USDA.

Vaidyanathan, A.
2006 Farmers' Suicides and the Agrarian Crisis. Economic and Political Weekly 41(38): 4009–4013.

Vakulabharanam, Vamsi
2004 Agricultural Growth and Irrigation in Telangana: A Review of Evidence. Economic and Political Weekly 39(13): 1421–1426.

Vanclay, Frank, and Gareth Enticott
2011 The Role and Functioning of Cultural Scripts in Farming and Agriculture. Sociologia Ruralis 51(3): 256–271.

Van den Berg, Henk, and Janice Jiggins
2007 Investing in Farmers—The Impacts of Farmer Field Schools in Relation to Integrated Pest Management. World Development 35(4): 663–686.

Vasavi, A. R.
1999 Harbingers of Rain: Land and Life in South Asia. Oxford University Press, USA.

Venkata Ratnam Bachu, International Institute of Information Technology, International Institute of Information Technology Krishna Polepalli, and International Institute of Information Technology G. S. Reddy
2006 eSagu: An IT Based Personalized Agricultural Extension System Prototype - Analysis of 51 Farmers' Case Studies. International Journal of Education and Development Using ICT 2(1). http://ijedict.dec.uwi.edu/viewarticle.php?id=95&layout=html, accessed October 16, 2014.

Venkateshwarlu, B., S. S. Balloli, and Y. S. Ramakrishna
2008 Organic Farming in Rainfed Agriculture: Opportunities and Constraints. Hyderabad: Central Research Institute for Dryland Agriculture.

Venkateshwarlu, K.
2006 Edaggrineelu Farmers Create History. The Hindu, October 12. http://www.thehindu.com/todays-paper/tp-national/tp-andhrapradesh/enabavi-farmers-create-history/article3060052.ece, accessed September 28, 2014.

Vijay, G.
2012 Telangana Movement. Economic and Political Weekly 47(37): 22–25.

Wadke, Rahul
2012 Mahyco Denies It Sold Its Seeds in Black Market. The Hindu. http://www.thehindubusinessline.com/industry-and-economy/agri-biz/article3658632.ece?homepage=true&ref=wl_home, accessed September 13, 2012.

Wang, Guiyan, and Michel Fok
2014 Farmer and Market Interactions in Using Biotech Cotton Varieties and Seed. A Case in Northern China. Journal of Development Studies 50(5): 696–714.

Watson, James
2006 Golden Arches East: McDonald's in East Asia, Second Edition. Palo Alto: Stanford University Press.

Wendel, Jonathan F., Curt L. Brubaker, and Tosak Seelanan
2010 The Origin and Evolution of Gossypium. *In* Physiology of Cotton. James McD Stewart, Derrick M. Oosterhuis, J. J. Heitholt, and J.R. Mauney, eds. Pp. 1–18. Dordrecht ; New York: Springer.
http://JE5QH2YG7P.search.serialssolutions.com/?V=1.0&L=JE5QH2YG7P&S=JCs&C=TC0000372295&T=marc, accessed April 1, 2013.

Wilken, Gene C.
1987 Good Farmers: Traditional Agricultural Resource Management in Mexico and Central America. Berkeley: University of California Press.

Willer, Helga, and Lukas Kilcher
2012 The World of Organic Agriculture - Statistics and Emerging Trends 2012. Bonn:

Research Institute of Organic Agriculture (FiBL), Frick, and International Federation of Organic Agriculture Movements (IFOAM).

Zohary, Daniel, Maria Hopf, and Ehud Weiss
2012 Domestication of Plants in the Old World: The Origin and Spread of Domesticated Plants in Southwest Asia, Europe, and the Mediterranean Basin. Oxford University Press.

Zubrzycki, John
2007 The Last Nizam - The Rise and Fall of India's Greatest Princely State. Sydney: Pan Macmillan.

Appendix A: Conventional Farmer Seed Surveys 2012-2013

2012 Survey

Village ________________________ Date_____________ GPS (H/F)_________________________

Irrigated?_________ Family____________________ Name_____________________________________

2013 -

Total acres planted__________________

Cotton ______________________________________ Acres________Town_________Vendor __________

Planted before?_____________How many times?___________________________Why that seed?

Rice ____ Acres________Town_________Vendor __________

Other Crops and acres____

2012 -

How many times sprayed? ________________________________

Worst insect problem? ____

Total acres planted __________ Total quintals harvested ___________Subsidy?________

Cotton Seed_________________________________ Acres________Town_________Vendor __________

Rice __________________________ Acres______Town_________Vendor __________#Saved bags for eat or replant?______________Bags harvested?_______________________

Other Crops and acres____

Garden/Source of germplasm?

Ask you?

You ask?

Worst problem facing farmers?

Clever farm experiments?

2013 Survey

Village ________________________ Date_____________ GPS (H/F)_________________________Age_________

Irrigated?_________ Name___________________________HHID_________________Caste___________________

2013 -

Total acres planted_________________Cotton______________________Acres_______Town____________Shop _______________Planted before?___________________________How many times?____________________SL/DL?

Rice ____ Acres________Town_________Shop __________Planted before?_______________________________________How many times?______________________________

Other Crops and acres___________________________([1-3] Cotton Sureness__________Rice Sureness__________)

2012 -

	How many times sprayed?	Worst insect problem Rice/Cotton?	Pachcha Purugu Vaccinda?
Rice:			XXX
Cotton:			

Total acres planted __________ Cotton Seed_________________________________Acres________ Total quintals harvested___________ Town_________Shop __________Planted Before?_______________How many times?____________________SL/DL?

Rice _______________________Winter rice?_________________Acres______Town_________Shop __________#Saved bags for eat or replant?______________Bags harvested?______________________ Planted before?___________How many times?_______________

Other Crops and acres____

Cotton seeds: Mixed together or separate this year? What's the difference between these brands?

Rice saved: What is the difference in the field between rice sold, rice for eating, and rice for replanting? Who chooses what rice is saved?

Rice not saved: Why not save your seed for next year's planting?

Do you plant Kamdulu in your field? Where do you get the seed?

Cotton Seed	Rice Seed
Boll size? Sucking pests? Many branches?	Thick or thin? Pest problems?

Caste:

Farmer Name	Sex	Age	Education	For how many years have you been a farmer?	How long cotton?	How long Bt?	How long rice?

A. Economic Assets			
1. Do you own livestock?		Tractor	
Buffalo		Machinery	
Cattle		Others:	
Others:		Soil type:	

B. Income			
Farm income last year?		**Family member name**	**Job**
1. Non farm income?			
From where?			
Workshare?			
Debt? From what?			
Who in the household worked off farm and what did they do?			

(If planting a new cotton/rice seed this year) Is this the first year this seed was available?

Who was planting this last year?

What did you yourself see?

What did you hear?

Why did you not you try this seed yourself?

What kind of farmers plant brand new seeds?

Are you planting Bt? What is Bt? What does it do? What kinds are available? Does it work?

Any new insect problems/diseases this year? How do you manage them?

If I asked for your help in choosing a new seed?

What do I look for and do to make sure that I was growing correctly (I'm stupid, lazy, etc.)?

(if trialing cottons) What do you look for? What kind of tests do you do?

How can you say that the results of the tests are due to the seeds rather than due to some environmental variable (land, water, bad season)?

(if saving rice) Can you describe the process of saving rice from harvest to replanting? What do you look for in the field when deciding to save rice?

2014 Survey

Village ____________________ Date_____________ Age__________Irrigated?_________
Name_______________________________________HHID__________________Caste____________________

2014 -

Total acres planted___________________Cotton_______Acres________Town____________________________
Shop_______________Planted before?_____________________How many times?___________________SL/DL?

Rice ____ Acres________Town_________Shop __________Planted before?_________________________How many times?_______________________________

Kamdulu: Town____________Shop____________Name?_____How many times?________________

Tomato: Town____________Shop____________Name?_____How many times?________________

Banti : Town____________Shop____________Name?_____How many times?________________

Other Crops and acres____________________________([1-3] Cotton Sureness___________Rice Sureness__________)

2013 -

	How many times sprayed?	Worst insect problem Rice/Cotton?	Pachcha Purugu Vaccinda?
Rice:			XXX
Cotton:			

Total acres planted__________ Cotton Seed_________Acres________Total quintals harvested___________
Town_________Shop __________Planted Before?_______________How many times?_______________SL/DL?

Rice __________________Winter rice?__________________Acres______Town_________Shop__________Total Bags

harvested?____________ #Saved bags for eat or replant?_________ Planted before?_____How many times?_________

Other Crops and acres____

Rice saved: How do you know to save rice for next year's planting? Who chooses what rice is saved?

Changing cotton or rice seed: Why change from last year's seed to this year's seed?

Cotton Seed	Rice Seed
Boll size 1-2-3 What pest enjoys this? Bt? Bushy or tall?	Thick or thin? What pest enjoys this? Bags per acre? Days until harvest?

Appendix B: Ethnobotanical Survey

Agrobiodiversity Survey: Economic Botany

Village _________________________ Date_____________ GPS (F)__________________________

Name_______________________________________HHID_________________________________

Age________________Sex__________________Plant Total_________________________________

What plants are used from the farm fields and for what purpose?

Commodity Crop plants planted (cotton 2012: S/D ||| cotton 2013: S/D):

Home need vegetables, flowers:

Intercropped/Separate____

Economic trees:

Wild foods (adavi aharam):

Wild non/foods (medicine, basketry, thorns, thatch, firewood, fodder, ornamental):

Notes:

Do you use any of the following from your field? (mark planted with checks):

Y?	Crops	Y?	Kurakayalu	Y?	Chetlu	Y?	Other Useful?
	Patti		Tomato		Vepa chettu		Amundum
	Wari		Bemdakaya		Toddy chettu		Banthi puwwu
	Makajuna		Vamkaya		Take chettu		kanakambaram
	Pesalu		Chikkudu		Mamidi pandu		Gulabi
	Palli		Palli		Thuma chettu		Tella malli puwwu
	Nuvullu		Kakkadakaya		Sitapaluka chettu		Kulabantha
	Michi		Gumadakaya		Tangedu chettu		Tulasi
	Pasupu		Gongura		Kalimaku chettu		Kagitapu puvvu
	Mamidi pandu		Dosakaya		Jama/Narenga		Bugladatamara
	Take chettu		Kamdulu		Chinta chettu		Mandara
	Shenigallu		Birakaya		Thuniki		Pama chettu
	Januwulu		Annakaya/Dondakaya		Jumpuda chettu		Gonneru
			Nallausri		Chendradi chettu		Jilledu
			Ulli gadda		Modugu chettu		Kalubanda
			Pesalu		Usiri chettu		Sita Jedda
			Minimulu		Sarkar thuma/ Mangalagiri		Juna
			Bubbarlu		Gangaressi pandlu		
			Buddam kaya		Mari chettu		
	Kayalu		Pappada kaya		Cheninga chettu		**Chetlu**
	Mulangi		Arati Pandu		Muktu chettu		Ralla Chettu
	Beetroot		Pullakura		edda lanka/Veduru		Kunkudukaya
	Sorakaya		Totorkura		Subav chettu		Alla Nerada
	Pudlu terugudu		Pudina		Regu Pandu		Chi Chintakaya
	Alum		Danyalu/Kotmir		Ita chettu		
	Brahma jemudu		Mentyalu		Nimba Chettu		
	Velulli		Carrot		Mukta		
					Gumpa chettu		
					Suporta Chettu		
					Mulli Kaya		

Are there any plants that you use that I missed?

Any plants that your husband/wife/children use?

Excepting the crops, do you sell any of the products of these plants?

If not selling, what do you use these plants for (all new plants, trees/other useful)?

(medicinals) How is this prepared?

Which are planted and which grow on their own? Do you do anything to help/hinder the non-planted?

Who in the household helps with farming?

Farmer Name	**Sex**	**Age**	**Education**	**For how many years have you been a farmer?**	**How long cotton?**	**Use Bt? How long?**	**How long rice?**

C. Economic Assets			
2. Do you own livestock?		Tractor	
Buffalo		Machinery	
Cattle		Others:	
Others:		Soil type:	

D. Income			
Farm income last year?		**Family member name**	**Job**
1. Non farm income?			
From where?			
Workshare?			
Debt? From what?			
Who in the household worked off farm and what did they do?			

Appendix C: Shop Survey

Shop Survey

Date____________________ Shop Name____________________________________

Top 5 seeds sold and number of packets sold?

	Boll size	# of flowers	SL/DL	Height	Water requirement	Suggested number of fertilizer treatements	Resistance to pests other than Pachcha Purugu	Soil Type	Picking
DB									
N									
Jack									
Jad									
M									
Bra									

What is the difference between these seeds?

Many farmers that we talked to confused Jackpot and Jadoo. Did the company market them together? Did farmers come in asking for Kaveri seeds? If they asked for Jackpot or Jadoo, did you recommend the other seed as well? Why are these seeds so popular this year?

	Yield per Acre	Spacing	Time to harvest	Suggested number of fertilizer treatements	Resistance to pests
VJM					
W14					
Jejelu					
1001					
1010					

Are any of the pesticides you sell chemically the same (like Nagarjuna Mida and Confidor)? What is the difference between these brands? What kind of farmers buy which pesticide?

In the same way, are any of the cotton or rice seeds you sell the same hybrid number or rice variety? What is the difference between these brands?

Appendix D: Organic Farmer Seed Surveys 2013-2014

2013 Organic Survey

Village ___________ Date_____________ GPS (H/F)_________________________ Irrigated?_________
Name_______________________________________HHID_________________Caste____________________

2013 -

Total acres planted__________________Cotton ________________Acres________Town____________Shop _______________ SL/DL? ([1-3] Cotton Sureness___________Rice Sureness__________)

Planted before?__________________________________How many times?____________________________ Rice ____ Acres________Town_________Shop __________Planted before?____How many times?_______________________________

Other Crops and acres____

2012 -

Times sprayed Neem mixture		Concentration	Worst insect problem
Rice:			
Cotton:			

Total acres planted __________ Cotton Seed______________________Acres________Total quintals harvested

___________ Town_________Shop __________Planted Before?____________How many times?__________SL/DL?

Rice __________Winter rice?_____________Acres______Town_________Shop __________#Saved bags for eat or replant?______________Bags harvested?____________ Planted before?___________How many times?______________

Other Crops and acres____

Cotton seeds: Mixed together or separate? What's the difference between these brands this year? Last year?

Rice saved: What is the difference in the field between rice sold, rice for eating, and rice for replanting? Who chooses what rice is saved?

Rice not saved: Why not save your seed for next year's planting?

Spacing:Chettlu__________Row/Row___________ Why? Since when? How do you keep track of the spacing? Who suggested this?

2013 R: What do people say about this seed? What do you see in your field?	2013 C: What do people say about this seed? What do you see in your field?

Farmer Name	Sex	Age	Education	For how many years have you been a farmer? (head of HH, if not interviewed)	How long cotton?	How long Chemical free?	How long rice?

E. Economic Assets			
3. Do you own livestock?		Tractor	
Buffalo		Machinery	
Cattle		Others:	
Others:		Soil type:	

F. Income			
1. Farm income last year?		3. Sales at market?	
2. Off farm income		4. Direct/Contract sales? About how much?	
Debt?		Reason?	

G. NGO involvement this year, last year	
Training programs/help	
Sales help	
Loans	
Infrastructure this year	

Cotton Rotation Schedule?

Rice Rotation Schedule?

What do you do to maintain:

Fertility	#Years	Insects	#Years	Water	#Years
Vermicompost		Vepa		SRI	
Penda		Jaggery/Mirchi/Garlic/Cow Urine		Drip	
Green compost		Traps			
Food compost		Trap plants (which)			
Pond soil					

Anything new this year?

Have you made any adjustments to any CROPS instructions (they show you how to do something and you discover a better way to do it)? Have you stopped using any of their suggestions (they show you something that doesn't work for you)? Have they started using any of your suggestions (you show them something that they decide to suggest to others)?

Impact of all the visitors?

Who do you ask for help when you have a problem or doubt?

What plants are used from the farm fields and for what purpose?

Commodity Crop plants planted:

Home need vegetables, flowers:

Intercropped/Separate____

Economic trees:

Non-planted foods on field edges or in field (like wild-growing kakkadakaya, etc.):

Non-planted non/foods (medicine, basketry, thorns, thatch, firewood, fodder, ornamental):

Notes:

2014 Organic Survey

Village _________________________ Date_____________ GPS (H/F)____________________Age________________

Irrigated?_________ Name_______________________________________HHID__________________

2014 -

Total acres planted___________________ Cotton __________________________________Acres________

Town____________Shop _______________ SL/DL? Planted before?__________________________________How many times?____________________________

Juna: gaurani? Acres____________ how many years____________ Rice___________Acres________town________ shop_________ how many years?_____________

Other Crops and acres____

2013 -

Times applied pest management		Method used	Worst insect problem
Millet/ Rice:			
Cotton:			

Total acres planted __________ Cotton Seed__________________Acres________Total quintals harvested___________
Town_________Shop __________Planted Before?_______________How many times?_________SL/DL?

Sorghum: gaurani? Q harvested_______________Saved bags for eat or replant?____________Acres________________

Other Crops and acres____

Cotton seeds: What's the difference between these brands last year?

New instructions?

Why not take seeds from outside?

2014 Juna	2014 C
Expected quintals? Days to harvest? Which insects are a problem?	Kaya size Which insect attacks Bushy or tall

Do you use any of the following from your field? (mark planted with checks):

Y?	Crops	Y?	Kurakayalu	Y?	Chetlu	Y?	Other Useful?
	Patti		Mirchi		Vepa		Amundum
	Pesarlu		Kamdulu		Ipa		Banti
	Minimulu		Tomato		Chimta		Jilledu
	Nuvullu		Bemdakaya		Regi pandu		Januwulu
	Shenigallu		Chikkudukaya		Biomass		Mudera
	Palli		Vamkaya		Jidi		Godayla
	Makajuna		Palakura		Kanuga		Vavila
	Soya		Totorkura		Sarkar thuma		Gadilan
	Gaurani Patti		Beerakaya		Veduru		Vedema
	Wari		Bubbarlu		Mari		Avu Juna
	Juna		Anumulu		Adavi Regi pandu		
			Kakkadakaya		Teak		
			Avallu		Thuma		
			Gongura		Muri		
			Sorakaya		Pariki		
					Billopatri		
					Sulimara		
					Valimara		
	Kayalu				Pappadakaya		**Chetlu**
					Rama		Mothu
					Sitapaluka		
					Rampalla		
					Jamma		
					Nimma		
					Modugu		
					Mamidi		
					Ala Neeradi		
					Subabol		
					Thuniki		

Are there any plants that you use that I missed?

Any plants that your husband/wife/children use?

Excepting the crops, do you sell any of the products of these plants?

If not selling, what do you use these plants for (all new plants, trees/other useful)?

(medicinals) How is this prepared?

Which are planted and which grow on their own? Do you do anything to help/hinder the non-planted?