Received: 10 July 2017 | Revised: 17 June 2018 | Accepted: 23 August 2018

DOI: 10.1111/joac.12295

ORIGINAL ARTICLE

WILEY Journal of Agrarian Change

Farmer knowledge across the commodification spectrum: Rice, cotton, and vegetables in Telangana, India

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Funding information
John Templeton Foundation; National Science Foundation, Grant/Award Number: 0314404; Volkswagen Foundation; National Geographic Society, Grant/Award Number: 9304-13; Jacob K. Javits Fellowship Program

Abstract

Crop seeds are a factor of production that can be produced on farm or bought, commodified in varying ways and degrees, and that can change slowly or rapidly—all of which directly impact the crucial process of farmer "skilling." Seed choices also offer a unique empirical window through which farmer knowledge may be studied. Although other studies have examined the differences between cash and food crops, this research provides new insights into varyingly commodified crops within the same agrarian system. When planting rice, genetically modified hybrid cotton seeds, and garden vegetables, farmers in Telangana, India, face different constraints and opportunities to learn about their seeds and practice that knowledge in the field. These differences arise from agronomic properties of the seeds themselves as well as from the sociocultural meaning that structures the context in which farmers buy, grow, and save them. This measurable discrepancy in farmer knowledge and experience presents an opportunity to examine the variable impact of seed commodification as it is experienced by the same group of farmers across several different crops. Building on theories of commodification and agricultural knowledge, we propose that the different ways in which farmer knowledge operates in these crops reflect a spectrum on which knowledge and commodification are inversely related.

KEYWORDS

commodification, indigenous technical knowledge, political ecology, South Asia

1 | INTRODUCTION

Seed choice is a fundamental decision for any farmer, one that sets in motion a cascade of future choices about tillage, pest management, fertility, budgeting, and labour. Although analysts differ in emphasizing how smallholding farmers seek out risky opportunities to get ahead (Henrich & McElreath, 2002) or stick to conservative decisions to optimize household security (Brookfield, 2001; Netting, 1993), scholarship nonetheless tends to generalize about smallholder farmer knowledge. Yet we find that even holding constant the group of farmers and the environment in which they farm, different seeds can lead to very different types of learning and decision-making. Farmers are not inherently risk-seekers or risk-avoiders but learn in a dynamic context defined by different seeds and commodification in a larger political economy.

During May and June, as farmers in Telangana, India, prepare to plant the cotton and rice that power their agrarian economy, villages buzz with gossip about the year's most popular seeds.[1] The rumours, decisions, and knowledge underlying them differ between crops. This discrepancy has consequences for both environmental management and for the knowledge that farmers develop when planting seeds that strengthen social and economic relationships, tie them to place, and make use of quotidian ecological skill. In this paper, we argue that the processes of agricultural skilling and decision-making—particularly in the crucial choices of seed—operate differently depending on how the crop is commodified.

Farmers considering their seed options encounter different social contexts that constrain their opportunities to learn and apply that knowledge when managing their fields. To an extent, these differences arise from inherent agronomic properties of the seeds themselves: Some are easily saved and replanted, whereas others must be newly purchased each year. But more significantly, these differences arise from the economic, social, and ecological relationships in which farmers grow them. Rice and cotton are only two points on a spectrum of commodification. Genetically modified (GM) hybrid cotton seeds are bred and sold exclusively by agribusiness, crossed between parent or grandparent and child lines and failing to produce hybrid vigour if replanted. This alone disrupts farmer knowledge (Fitzgerald, 1993; Stone, 2007), but these seeds are additionally aggressively branded and sold in a confusing market defined by outside expertise. By contrast, heirloom garden vegetables are exchanged as gifts, purposively saved, and maintained through a specific local knowledge that values place, the history of the seed, taste, and colour as much as yield or resale value. Between these two poles are open pollinated variety (OPV) rice seeds that can be bought, saved, sold, or eaten on Telangana farms. Unlike hybrid crops, OPV rice seeds and heirloom vegetables exchange pollen. Such seeds will not express hybrid vigour when sown, but they can also be saved and replanted without risk of diminishing yields. This roster of seeds presents an opportunity to examine how the same population of consumer–producer farmers build gradations of commodity knowledge and production control across different crops. Although we will use seeds in this paper as a point of departure to explore commodification, our spectrum refers to the crop in question, encompassing the use-value seed and the exchange-value commodity, as well as the inputs, labour, and farmer knowledge required to manage the crop. The ways in which these crops are grown, sold, and learned about vary as a function of the degree to which elements in each crops' cultivation are commodified. This variability suggests a spectrum across which farmer knowledge and the degree of commodification are inversely related. We consider four points along this spectrum, representing crops all planted by the same farmers in the same fields: heirloom vegetables planted in field gaps, OPV rice seeds, hybrid rice seeds, and GM hybrid Bt[2] cotton (Figure 1).

On this spectrum, farmers experience different ways of accumulating agroecological knowledge about their crops, building relationships with others including neighbours, shops, relatives, and the plants themselves, and using that knowledge at the marketplaces where they buy seeds and sell their harvests. The differences between these

[1]Telangana officially split from Andhra Pradesh in June 2014, midway through this project.

[2]Bt refers to *Bacillius thuringiensis*, a bacterium from which genes coding for Cry proteins lethal to Lepidopteran insects are added to GM crops.

FIGURE 1 Crop knowledge and the commodification spectrum

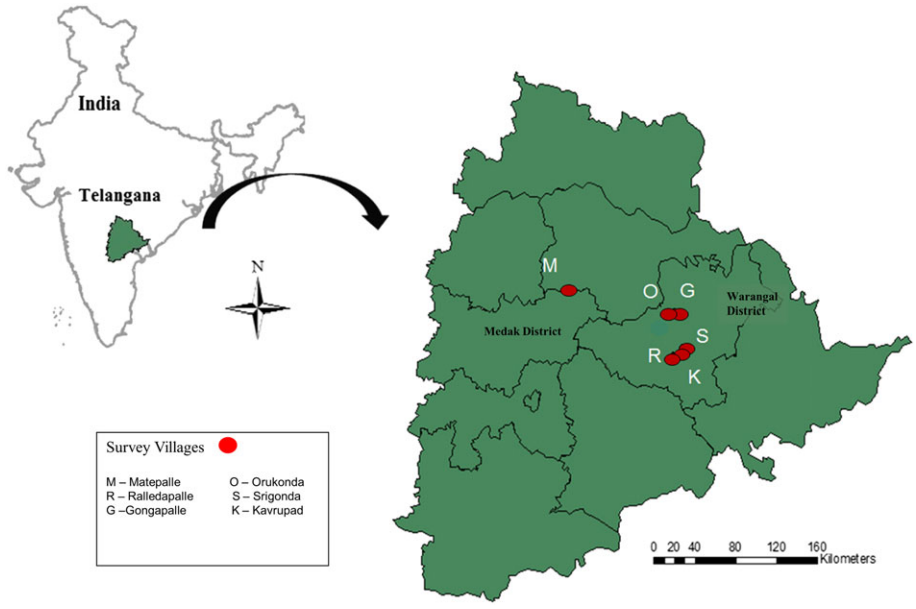


FIGURE 2 Survey villages in Medak and Warangal Districts of Telangana, India (as visited in 2016)

seeds and their markets produce compounding and synergistic effects in how farmers generate knowledge about seeds, how they manage their crops in the farm field, and the social meaning that accompanies these practices. These differences are reflected in how seeds are saved, in the influence of commercial branding, and in the role of outside experts in agricultural decision-making.

We begin by exploring the relationship between commodification, knowledge, decision-making, and ownership in agrarian studies literature. Then, we draw on longitudinal survey and ethnographic data concerning the seed choices of farmers in six Telangana villages (Figure 2) to examine the relationship between knowledge commodification in four seed categories.[3] We conclude by arguing that the range of markets and practices structures possibilities for farmers to learn about their seeds, forge social relationships, and participate in local and global economies.

1.1 | Commodification and agroecological knowledge

Commodification demands continuous social work to make products legible to consumers (Kopytoff, 1988), who themselves create new meaning through and with those purchased products (Appadurai, 1996; West, 2012). Several aspects of smallholder agriculture are ill-suited to the commodification that characterizes industrial capitalism: The alienation of workers from tools, the specialization of labour, the concentration of knowledge and ownership of the means of production among owners, the clear distinctions between owners and labourers, or the clear distinctions between use and exchange values held by commodities. Although commodities are assessed on the market

[3]All village and interlocutor names have been changed.

by their exchange values, the relative abstractions of labour and valuation, agricultural products also have obvious use values, the material purposes of goods. Vegetables and grains can be eaten, whereas seeds can be saved for future use. Kloppenburg (2004) argues that seeds are a fundamental means of production, and others point out that small farmers may own or effectively own their land and fertilizer-producer draft animals. As such, they maintain a general knowledge to manage these diverse inputs (Brookfield, 2001; Netting, 1993).

In intensive small farming the household unit provides crucial labour and management knowledge (Netting, 1993). To gain a foothold in this farming sector, agricultural commodification has disrupted household knowledge and management since the early 20th century. Waves of agricultural experts declared farmers incapable of rational, scientific management and aimed to supplant farmer knowledge with an industrial logic (Fitzgerald, 2003). The resulting uncertainty created a market for the discrete commodification of different parts of the farming process by the burgeoning agricultural industry, a process that Goodman, Sorj, and Wilkinson (1987) call appropriationism. Both Marx and his followers hesitated on the issue of commodification, knowledge, and labour in agriculture. Where Marx (2008) once infamously described rural societies as having all the social complexity of a sack of potatoes, Kautsky (1988) later suggested that small farms continued to exist because they found opportunities for marginal land and specialized labour that larger farms could not efficiently use, Chayanov (1966) ascribed their persistence to self-exploiting household labour, and Mann and Dickinson's (1978) classic essay in agrarian political economy argued that capitalism's tendencies to merge production and labour time itself provided a niche for small farms that could accept narrower profit margins and wait long enough for agricultural products to become profitable. Marx (1939) himself gave more time to the complexities of agrarian political economy in the *Grundrisse*.

Marx's commodification is not only the alienation of workers from tools but also the promotion of a labour that breaks social links and management knowledge. Seeds bought and sold each year to produce products for sale are commodities, where seeds saved, traded, and kept for their use value maintain links between farmers, require local selection and breeding knowledge, and may be kept for aesthetic qualities beyond their market value. Predicting that agriculture could become a capitalist industry through these dissociations, Marx (1939) cautioned that the gradual appropriation of farm activities by capital and the transformation of former means of production into commodities to be bought would draw farmers into the "historically created necessity" (p. 527) of buying farm inputs to produce for markets. Out of that necessity, contemporary Telangana farmers, like all farmers engaged in the agricultural commodity economy, buy crop seeds bred by agricultural scientists to respond to an integrated suite of fertilizers, pesticides, and irrigation. Such seeds are the continuation of an investment-intensive agriculture defined by external chemical inputs, state subsidies, monocultures, and a set of specific knowledge that rests with experts external to the farming household (Brookfield, 2001; Fitzgerald, 2003; Kloppenburg, 2004). On Telangana farms, the same people make different kinds of decisions about hybrid, OPV, and heirloom seeds, and these seeds lead farmers to different agricultural practices tied to a variable importance placed on local variation, profit, and farmer knowledge.

The relationship between knowledge and things, as well as the potential for that relationship to become a consumer product, is a recurrent theme in studies of commodification. A classical Marxist approach to things and the power relationships inherent in the commodification process (Marx, 1867) focuses on the expropriation of labour surplus for profit: Labourers work on commodities to produce new commodities for the market. This theoretical description of commodification is absolute, alienates producers and consumers, and ultimately divides society into classes. Within this framework, knowledge and decision-making are wrested from farmers only to be sold back to them. Heidegger (2012) lamented the loss of craft knowledge and the social connections between producers and users that occurred when things became commodities—a handmade jug overflowed with social meaning, skill, and connection, in a way that an industrially produced bottle of Coca-Cola did not (Latour, 2004). Commodification severs the ways that things connect producers and consumers, and it disrupts the knowledge of craftsmanship. On the farm, commodified seeds lose their links to breeders and landscapes. They become only an investment to be bought in search of profit, a view of crops van der Ploeg (2010, p. 4) describes as farming "reduced to a mere conversion of commodities (that might originate from anywhere) into other commodities (that might be destined for any location)". Yet this process is rarely as complete as that kind of hardline Marxist analysis would imply.

1.2 | Commodification within small-scale agricultural systems

It is difficult to permanently alienate workers from their tools or consumers from commodities. Arjun Appadurai (1988), working from a postcolonial perspective, celebrates the ways in which people around the world make commodities and modernity (Appadurai, 1996) meaningful on their own terms rather than through the unrelenting teleology of development, states, or global capitalism. Commodities may be stripped of their original production context and knowledge through global trade, but they acquire new social meaning through the lives and relationships of those who encounter them (Appadurai, 1988, p. 41). This is especially true in agricultural systems, although these new social meanings always articulate with the larger political economy. New institutions and brokers claim power as agriculture becomes more enmeshed in global commodity networks, leaving small farmers reliant on intermediaries who enforce quality standards (Benson & Fischer, 2007), or incentivizing boom crops that require heavy investments and outsider knowledge (Keyder & Yenal, 2011; Münster, 2015). Postcolonial studies of Indian agriculture have shown how farmer and neoliberal market knowledge hybridize (Gupta, 1998; Vasavi, 1999), fostering Avyurvedic notions of plant health aligned with new chemical subsidies pushed by the central government during the green revolution. More recently, soya seeds gained currency in Madhya Pradesh as farmers and brokers discovered new ways of interacting with electronic pricing information (Kumar, 2015).

Studies contrasting simultaneous commodity and subsistence agriculture systems (Dove, 2011; Maat & Hazareesingh, 2016; West, 2012) have shown that subsistence and heirloom crops require special care because their cultivation is not merely the production of a commodity but the continued stewardship of germplasm linking growers to relatives and place. Alternately, scholars have called some crops anti-commodities because they are part of a system of agriculture that allows farmers to escape or remain illegible to state authorities (Scott, 2009), because they are grown for local, practical use value (Hazareesingh & Maat, 2016), or because they serve a particular non-trade-based social or subsistence value (Glover & Stone, 2017). Crop knowledge can also vary as a function of community labour organization and agricultural management. Noting that farmers achieved uniformly higher crop yields with high-yielding varieties (HYVs) of wheat but uneven yields with HYV rice during India's Green Revolution, Munshi (2004) argues that heterogeneous rice agricultural practices restricted social emulation and the diffusion of knowledge. Although Munshi misses an opportunity to consider the axes of commodification or local input shops alongside management strategies in his study of farmer learning, he shows that wheat agriculture was more homogenous and allowed farmers to learn from each other more easily—even in districts where both HYV rice and wheat were planted by the same farmers.

In some agrarian systems, commodity crops engender parallel knowledge. Although Papua New Guinea coffee agroforestry relies on commodity and subsistence agriculture, Paige West (2012) argues that Gimi-speaking cultivators consider coffee to be outside the social relationships and exchanges that meld humans and plants through obligations of care and rebirth (p. 127). Where sweet potatoes are social beings with kin obligations governing their care, coffee, a commodity, has value only as a return on monetary investment. The coffee plants arrive as saplings grown in foreign soil, and coffee is neither consumed nor exchanged in these villages. Their management is a function of technical advice rather than ritual and traditional knowledge because coffee is external to the Gimi world of reciprocity and rebirth. Where sweet potato cultivation is a necessary part of maintaining social relationships with ancestors and relatives, West observes that coffee is simply "money in the bank." The failure of a coffee crop may be economically devastating, but it is not an existential disaster.

Similarly, Michael Dove (2011) contrasts the dual moral constrictions of a subsistence, swidden rice crop and the monetized, market-oriented cultivation of rubber trees in Borneo. Because swidden cultivators understood agriculture as part of a cycle of exchange and regrowth within their larger socioecological community, crops like rubber that do not participate in the swidden cycle were seen to "kill" the exchange and thus kill the land. In disrupting this traditional management, Dove observes that "when rubber was first introduced to the Dayak early in the twentieth century, it was feared that the rubber trees would eat the spirit of the swidden rice" (Dove, 2011, p. 178). Colonial rubber knowledge and technology, including saplings, supplanted the authority of traditional land managers, leading

smallholders to create innovations within a commodity crop system and abandon land that would be otherwise used for rice (Dove, 2000). In both Papua New Guinea and Borneo, cash crops arrive from foreign breeders and are sold to foreign buyers. Where Gimi-speaking coffee cultivators separate the knowledge and practices of an outsider coffee tree commodity from their agricultural system, Borneo's indigenous rubber planters saw purchased saplings as actively destroying traditional land use practices and the socioecological relationships that came with them.

This relative lack of knowledge or power within the commodity chain makes agriculture riskier for farmers. Coffee and rubber are bred off the farm, require smallholders to bear the cost of their investment, and are sold according to global pricing and standards set by stakeholders further down the supply chain that farmers will never meet. Within a larger political economy, these shifts to commodity crops can have devastating consequences. As Watts (1983) has argued, the famine of the Nigerian Sahel in the 1970s–1980s resulted from a series of political and economic shifts that pushed farmers away from local subsistence grains and towards commodity groundnut production. When that market collapsed, Nigerian smallholders had neither subsistence resources nor cash reserves to weather drought and population pressure. These examples illustrate how commodity agriculture disincentivizes agroecological practices that build indigenous technical knowledge while simultaneously binding farmers to trading stakeholders who control crop knowledge and pricing.

The commodification spectrum that we describe in this paper does not arise because some crops are strictly for subsistence or use value, whereas others are strictly for cash or exchange value, or because the seeds are part of an active anti-commodity resistance. Rice, vegetables, and cotton have been cultivated for millennia in India, and farmers use a mix of hired labour and chemical pesticides and fertilizers to manage these crops. The variability in agricultural knowledge and commodification stems from the seeds themselves and ripples through these crops' management practices. Cotton seeds have become increasingly linked to a set of related technological practices, including insecticides, fertilizers, crop spacing, and herbicides, which we have theorized elsewhere as a process that limits farmer options in favour of agribusiness expertise and commodities (Stone & Flachs, 2017). By contrast, rice and vegetable seed production has maintained elements of local farmer selection and knowledge-intensive management. In making decisions about these crops, the same farmers will experience different opportunities to learn, enter into different relationships with neighbours, relatives, shops, or plant breeders, and satisfy different market and non-market obligations. Rather than experiencing their seeds as commodities or anti-commodities, we suggest that these farmers experience seed commodification as a spectrum. This is especially true of farmers caring for plants, who buy, sell, care for, and have a variety of social and economic obligations to their crops.

Two aspects of this relationship are most important to this essay: (a) the changes in farmer management knowledge that occur when seeds become commodities and (b) the emergence of actors who step forward as new experts and knowledge purveyors. That is, we are primarily concerned with the role of different modes of commodification in seed saving and selection, especially in how farmers interact with seeds as both producers and consumers. How farmers produce their seeds and the markets that structure their consumption create possibilities for farmers to build or buy skill and labour congealed in a product. Looking to seed selection as a form of skill, Stone (2007) used cotton seed decisions to theorize *agricultural deskilling*, a process separate from what Braverman (1998) described on the factory floor. Having traded the iterative knowledge of seed choice first for hybrid seeds in the 1990s (Basu & Paroda, 1995) and then GM hybrids in the mid-2000s, farmers adopted GM seeds *en masse*, without knowing the agronomic properties or even the names of the seed brands they purchased (Stone, 2007; Stone, Flachs, & Diepenbrock, 2014). Farmers also interact with seeds as consumers, and recent anthropological work has noted the ways that consumers shape global commodities to meet their local social needs (Appadurai, 1996; West, 2012). Crops that can be purposively saved, given as gifts, gathered, or bought on store shelves run the gamut of commodification as a process in which things signify various social relationships and maintain or alienate farmers from management knowledge. These different kinds of exchange coexist on Telangana farms, allowing farmers to make comparatively risky and conservative decisions depending on the crops in question. These decisions, rooted in the seeds' variable commodification, create opportunities for different sets of knowledge, management, social relationships, and engagement with agribusiness.

2 | METHODS AND FIELDWORK

The data referenced in this paper draw on interviews and surveys conducted in six villages, chosen to represent farmers from a variety of castes, ethnic backgrounds, village infrastructure, and proximity to cities, between 2012 and 2016 in the Warangal and Medak Districts of Telangana (erstwhile Andhra Pradesh), India. The authors spoke with farmers in 393 households drawn from a random, wealth-stratified sample of households in these villages. This strategy maximized the representativeness of our survey data with respect to caste and landholding size. Farmers held, on average, six acres of land with a median of five acres. We selected villages to represent both fringe rural communities with relatively little access to urban infrastructure and farming communities relatively close to urban centres. Beginning in 2013, we conducted more long-term ethnographic work including participant observation, non-structured interviews, and a consensus analysis that measured agreement on phenotypic crop qualities in these villages. This research design allowed us to interview the same farming households during multiple cotton seasons, to gain data on crop knowledge representative of Warangal cotton farmers as a whole, to interview farmers with and without local research assistants, and to observe social, economic, and ecological changes over time.

Throughout this paper, we tend to refer to farmers in aggregate so that we can compare the range of variation in seed choices and knowledge across different crops. Although there is not space in this paper for a true analysis of class and caste-based variation in Telangana, we have noted how agricultural knowledge and practice can differ across axes of gender, between farmers belonging to ethnic Telugu castes and scheduled tribes (STs), and between larger and smaller holding farmers.

2.1 | Aggressive commodification in the cotton seed market

Like most Kavrupad farmers, Prakash had never before planted the cotton seeds that he sowed in 2014, but he had heard from fellow villagers that a new seed, Yuva, would produce large, profitable cotton bolls. When asked how he could predict boll size without seeing it, Prakash pointed to the picture on the front of the package, saying, "the boll is right there. This picture shows what it will look like when we harvest it." When asked if such advertisements often turned out to be true, Prakash shrugged and looked away. "Sometimes," he answered noncommittally. In the aggressively commodified cotton seed market, farmers refer to seeds as "famous" and justify their purchases in the hopes of achieving a "good yield" (Telugu: *manci digubadi*). Yield, a proxy for profitability and success with cotton, is by far the most important cotton quality reported during interviews and surveys, and farmers choosing cotton seeds embrace the classical Marxist process by which commodities are transformed into different commodities at a profit.

The experience of Prakash is relatively common among Telangana cotton farmers. Directly contradicting the seed industry dogma that farmers adopt seeds only after careful scrutiny and experiment (Stone, 2007, p. 67), nearly half (44%) of all cotton seeds chosen by farmers in 2012–2015 were "novice" (first-time) plantings, lacking first-hand knowledge on which to judge those seeds' potential (Table 1). Indeed, sample farmers replanted their cotton seeds an average of only 1.77 times in 2012–2015, preventing them from learning much about any particular seed's efficacy in the field or the agronomic quirks of those seeds. Farmers wishing to test different seed brands have been seen to unwittingly plant the exact same seed (Figure 3), whereas spurious seeds bred by counterfeit companies and sold by black-market brokers add even more anxiety and confusion to the dynamics of deskilling in cotton agriculture (Stone, 2016, pp. 7–8).

TABLE 1 Novice cotton seed selection in 2012–2015 (n = 1,779)

	Seed choices	Percentage of total seeds
Novice	789	44.4
Repeat	990	55.6

FIGURE 3 Comparison of cotton and rice packaging. Cotton packages (right) are flamboyantly branded—here, the mixed metaphor of a chicken laying golden eggs under the brand name Jaadoo (Hindi for magic) is contrasted to the decidedly unflashy rice variety (left), July 30, 2014. (Photo by lead author)

Overwhelmed by an oversaturated market with hundreds of difficult-to-distinguish choices, or even sold black-market counterfeit seeds, farmers like Prakash are as likely to choose seeds on their marketing, on the advice of shop owners, or by following the crowd. This behaviour has nothing to do with gullibility or lack of savvy by farmers like Prakash. Their relationship to the seed as a high-stakes consumer product is in many ways similar to the experience of American office workers who defer to human resources representatives when overwhelmed by a swath of complicated 401k retirement plans (Iyengar, Huberman, & Jang, 2004) or college-educated American farmers barred from learning the details of hybrid maize seeds (Ziegenhorn, 2000). In this hyper-consumerist market, seed choices, a decision with economic stakes relating to household indebtedness and social stakes relating to social standing, are decisions that farmers who depend on that harvest feel unqualified to make.

As available GM cotton seed brands jumped from 3 to 899 in a matter of years, a different seed or seed pairing has risen and fallen in popularity each year since 2012 (Figure 4), continuing a decade-long trend in short-lived seed popularity that we have called herding behaviour (Stone et al., 2014). The successive favorites do not reflect a succession of ever-improving seeds but rather a variety of reasons for switching seeds. In 2013, the presence of a few especially productive farmers, an advertising blitz for a new seed, and a suspicion that seed companies produce subpar seeds the year after they enjoy widespread popularity helped push Kaveri's Jaadoo and Jackpot to new heights. Despite no clear first-hand feedback, farmers abandoned the previous year's sure bet for two new, relatively untested seeds. During the harvest of 2013, yields were essentially equal for the six seeds that defined cotton fads in 2012–2015 (Figure 5). As in Stone's (2007, p. 83) analysis of farmer seed choices, there remain relatively few

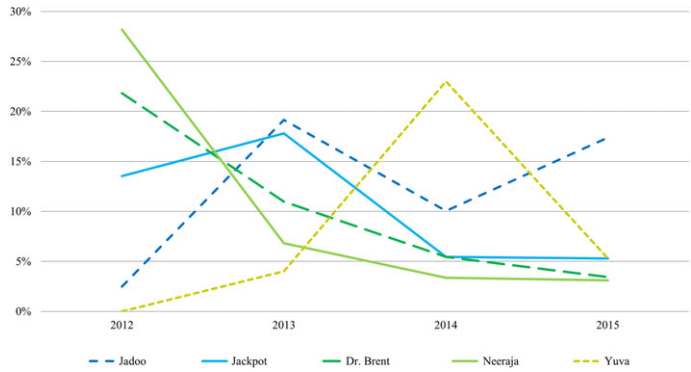
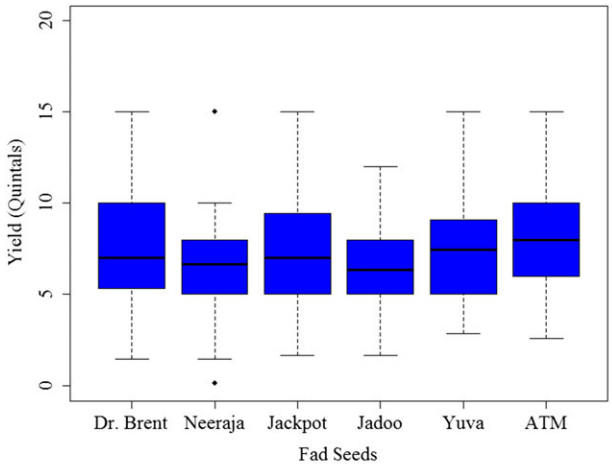


FIGURE 4 Cotton seed choices as a percentage of total choices for most popular seeds in 2012–2015 (n = 1,836 seed choices)



	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
p value of difference in means between given seed and all others determined by t-test	.22	.19	.81	.10	.60	.08

FIGURE 5 Comparative 2013 fad seed yields (Adapted from Flachs, Stone, & Shaffer, 2017). Differences in yields of any given seed were not significantly different from the yields of other seeds. Source: Lead author. Farmer Survey 2012–2014

differences in the phenotype or yield response of various seeds in farmers' fields. More importantly, farmers have no consistent way of tracking the differences between phenotypic characteristics such as branch architecture or leaf hairs because pests, weather, and inputs vary between farms. Further, many agricultural management practices between seeds are similar between farms as farmers do not have nuanced local knowledge differentiating seeds' predicted phenotypes, and a dramatic event like a late rainstorm would flood cotton fields regardless of how informed a farmers' seed choice is. Although yield was the ubiquitous answer justifying the switch to new seeds, farmers abandoned one seed for another despite no discernable difference in yields. Lacking time to learn about particular brands, farmers switched cotton seeds frequently and dramatically in 2012–2015.

Farmer knowledge suffers under these circumstances, in which farmers rapidly switch seeds, emulate their neighbours to make seed decisions, and relate to the seeds as consumers of commodities seeking to create another commodity. This can be measured through a consensus analysis, a tool to analyse agreement, of rice and cotton knowledge. Although agreement on phenotypic qualities does not necessarily mean that the farmers were "correct" in describing a particular seed's attributes, it does indicate that farmers have a widespread agreement about some quality, such as a seed's predicted boll size. For each cotton seed choice, we asked farmers to predict boll size and growth habit (Appendix A). For rice seeds, we 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 (Appendix B). These factors are important agronomic indicators espoused by farmers and reflect the management for and yield potential of these crops.

Boll size and growth habit, defined by farmers' taxonomy, are easy to observe and crucial factors for cotton agriculture, as these reflect yield, fertilizer response, and susceptibility to pest damage. Although dependent on inputs, weather, and soil conditions, these phenotypic factors govern farmer seed decisions. Yet the spread of these data shows a consistent divergence of farmer opinions. More than half of farmers planting a given seed rarely agreed on boll size or growth habit, whereas "I do not know" was often as likely an answer about a seed choice as anything

else. Linguistically, farmers often couched their descriptions by placing the suffix "-ta" at the end of their verbs, indicating that their descriptions were based on second-hand knowledge that which was hoped for but not confirmed.

In Telangana, our previous work (Flachs, 2016; Flachs, Stone, & Shaffer, 2017) has shown that decision-making, if not knowledge itself, can vary between farmers of different ethnicities and of different landholding sizes. ST farmers, who tend to be relatively poor and uneducated, were more likely to seek out new seeds and plant fad seeds than their ethnic Telugu caste counterparts. Meanwhile, the largest 20% of surveyed farmers tended to prefer fad seeds before they became popular, helping to push farmers in general towards the fads. Marginal farmers will sometimes simply ask larger and more prosperous farmers to select seeds for them. Importantly, these larger farmers and early adopters of what become fad seeds do not have significantly better yields, know more about their seeds, or plant them for longer than other farmers. As much as larger farmers may help nudge village and district trends in seed buying along, they too are caught up in these fads. Our spatial analysis (Flachs, Stone, & Shaffer, 2017) of these farms showed that the presence of a seed in a neighbour's farm was a much better indicator that a farmer would plant a seed than its yield, the holdings of the farmer planting it, or the number of years of experience that a farmer had planting that seed. The cotton seed market has been fundamentally transformed by the explosion of branding in the private GM hybrid seed market, enabling a cascade of related changes in farmers' experiences buying, managing, and selling these crops. Where cotton seeds changed rapidly across this agricultural geography, Warangal farmer rice seed choices, embedded in a more stable market and daily practice, remained far more stable across time and space.

This dissociation of labour, seeds, and management knowledge in cotton agriculture has been decades in the making. In many cases, the people buying seeds are not the people doing the daily work of cotton management. Although men do much of the actual purchasing, most households hire female labourers to weed their crops. This is a variability that touches both class and gender. Female, and occasionally male, labourers gain production knowledge through a nuanced daily practice of plant management in which every plant is touched and inspected. However, this skillset does not cross back across gender and class lines to landowners. Male and female farmers who buy seeds will still inspect their cotton to watch for signs of disease, but upon seeing an unfamiliar pest or problem, they usually turn to shops for management advice—which inevitably comes as a recommendation to buy a new product. As costs rise, farmers take advantage of expanded but predatory microfinance institutions (Taylor, 2011). The hope for a good yield by some new seed to counter rising debts perpetuates cotton seed uncertainty, leading farmers to seek external knowledge and products to keep their farms financially viable. Increasingly, these seeds constrain farmers to the most commodified form of small-scale agriculture, where dissociated commodities are bought to produce other dissociated commodities for sale (van der Ploeg, 2010). Over the last four decades, cotton farming management knowledge has become increasingly separated as farmers passed through a series of technological treadmills that each encouraged farmers to become more reliant on external information and commodified products associated with cotton agriculture: Hybrid seeds, pesticides, GM hybrids, and most recently crop spacing and herbicides have all separated farmers from on-farm management knowledge and introduced new rounds of technologies for farmers to buy (Stone & Flachs, 2017).

In this market, farmers are limited by rapid turnover in which a multitude of seeds are planted, often for the first time, and quickly abandoned in favour of new seeds. This limits their ability to build nuanced, local knowledge about those seeds, and so they generally disagree about important phenotypic qualities of seeds even as they are generally herding towards those seeds. Although farmers name yields as the most important factor in cotton agriculture, the seeds that capture market shares and farmer imaginations in each fad year have no measurable yield benefit to those farmers. Instead, on this edge of the commodification spectrum, farmers trade in uncertain rumours about brands rather than seed qualities. Prakash and innumerable farmers like him have learned to choose seeds based on the pictures and branding, even turning to unreliable brokers to secure fad seeds when growing cotton. Unaware of the specific history of the seed or the knowledge required to create it, farmers instead seek out brands. The market is all too happy to fill this gap—advertisements for seed brands hang from trees, decorate the public buses, and fill newspapers, and during the 2014 cotton planting and election seasons, cotton advertisements scrolled across the bottom of televised campaign speeches. Because of the lack of first-hand knowledge, the influence of corporate

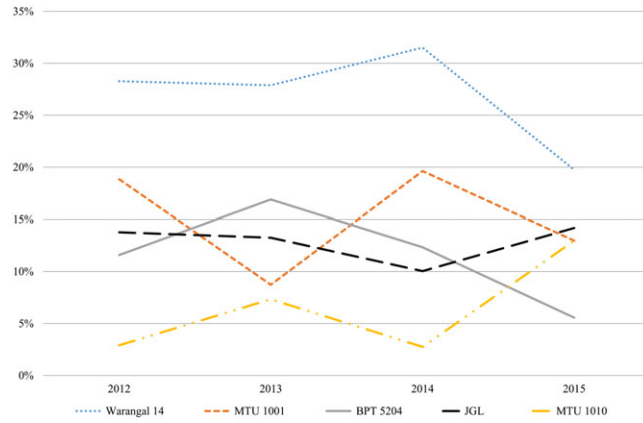


FIGURE 6 Rice seed choices as a percentage of total choices for most popular seeds in 2012–2015 (*n* = 874 seed choices)

branding, and the emphasis on off-farm expertise in production, cotton seeds occupy the most commodified edge of the spectrum of Telangana farmers' seeds.

3 | ALIGNED KNOWLEDGE IN THE MARKET AND IN THE FIELD IN RICE AGRICULTURE

The market in which farmers buy and sell OPV rice seed and daily practice of OPV rice agriculture is comparatively well suited to the development of agricultural skill and a relationship to the thing beyond its service in creating commodities and surplus profit. Unlike GM hybrid cotton, rice seed is mostly bred by public breeding centres. Records from the Indian Council of Agricultural Research show that since 1965, public breeders have released only 219 commercially popular OPVs (197) and hybrids (22) in Andhra Pradesh/Telangana. This is fewer new seed types than GM hybrid cotton companies release in a single year. In a given shop in the Warangal district, farmers are likely to encounter at most a dozen different rice seeds compared with more than 50 different hybrid cotton brands. This discrepancy occurs in our sample as well. Farmers in our study villages planted 112 different cotton seed brands in 2012–2015 while planting only 61 different types of rice seeds.

The aggregate seed choice patterns of surveyed farmers illustrate the contrast between rice and cotton seed choices and their replacements in the field (Figure 6). GM cotton seed choice is a high-investment, high-payout gambit characterized by frequent switching to chase the latest yield rumour. Unlike the last several years of cotton seed buying patterns, which are defined by dramatic switches in seed popularity, the same rice seeds remain popular over the years, their market shares are less dramatic than those seen at the height of cotton fads, and their fluctuations in popularity are more stable. Regional favourite, WGL-14, bred at the local research station, combines the taste and slender grain qualities of a popular parent line with an improved resistance to local pests and viruses.[4] Farmers know and recognize these qualities, allowing WGL-14 to remain popular while the cotton seeds rise and fall.

Farmers develop and investigate these distinctions by handling rice directly. Local taxonomies distinguish rice by grain thickness and taste, whereas farmers plant rice according to longer term, non-faddish patterns. Unlike the cotton seeds, farmers run their hands through rice seeds, starts, and crops ready to harvest, noting variation and damage. Rice cultivation is a nuanced process (Figure 7) of change and becoming, sometimes literally as in the Telugu word *annum*, which signifies both rice and food. Aside from this straightforward difference between rice and cotton harvests, the

[4]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.

FIGURE 7 Rice farmer preparing seeds. Farmer prepares rice seeds for nursery, inspecting grains for signs of damage or irregularity, July 24, 2014. (Photo by lead author)

labour relationships required to manage each crop are fundamentally different. On small Telangana farms, cotton labour draws on teams of hired workers and purchased chemicals. Although these are certainly present in rice agriculture, the actual labour is often more communal and managed by relatives and neighbours. Rice fields must be shaped, flooded in coordination with neighbours, and transplanted and harvested within short time frames. During the green revolution, Munshi (2004) has shown that rice agriculture was a heterogenous practice dependent on local knowledge, reciprocal local labour, and responses to changing field conditions. This labour is necessarily more based in local social relationships than cotton management, which has historically been harvested over a longer duration and often managed by slaves or sharecroppers who had no control over planting or management practices to begin with.

Kumar (2015) shows that farmers checking soyabean quality at markets may not be able to reliably predict seeds that will be more productive because they do not have well-established and multidimensional qualitative knowledge about soya, a commodity crop sold largely for its exchange value. Similarly, farmers do not care much about cotton's quality per se, only the price that they can sell it for at the market. Yet rice is grown partly with its use value in mind, in accordance with local norms that determine what "good" rice is, looks like, or tastes like. Thin varieties fetch higher prices but yield less, whereas thick varieties yield more but fetch lower prices in the market. Farmers overwhelmingly

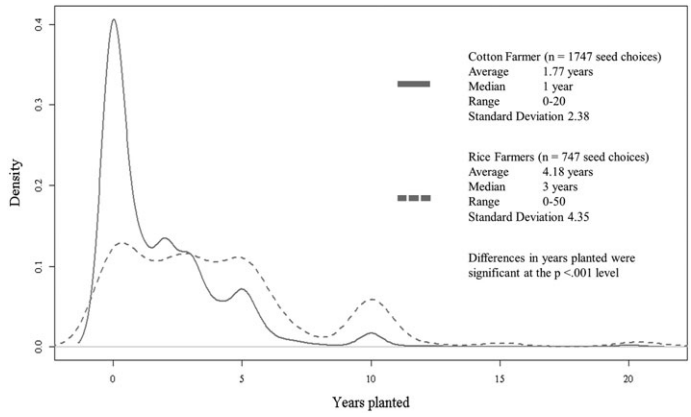


FIGURE 8 Years rice and cotton seeds sown by farmers in 2012–2015 as a frequency distribution (*n* = 393 farmers)

agree which seeds are which, and buyers offer prices accordingly. Furthermore, unlike the changing cotton brands, a 2014 focus group of farmers insisted 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." This is reflected in the relatively stable and relatively well-reasoned rice choice patterns. Rice can be eaten, stored, sold, and saved, and its management requires a set of specific local knowledge.

Because rice seed choices are much more consistent over the 2012–2015 period, farmers can spend more time learning more about particular seeds. Rice seeds were planted on average for over twice as many years as cotton seeds (Figure 8). Compared with cotton, rice seed choices benefit from more time, more stability, and fewer confusing brand choices. Given these differences in planting experience, it is unsurprising that rice seeds are less likely to be novice plantings. Only about 20% of rice choices (Table 2) were first-time plantings, compared with the 44% of novice cotton seed plantings sown by the same farmers. As demonstrated by the consensus analysis (Appendix B), these differences manifest in a farmer population that knows which rice seeds are thick and therefore more disease resistant, higher yielding, and likely to fetch a lower price in the market, as well as those which are thin and therefore more susceptible to disease, lower yielding, and can be sold at a higher price. During surveys, farmers remember rice choices with greater certainty each year than cotton, and the differences are easily observed across fields and in the marketplace. In the consensus analysis, rice seed thickness is almost universally known, and there is a high degree of convergence around germination time and overall yield. Almost no farmers mistake thick seeds for thin seeds, and more than 60% of surveyed farmers agree on the number of days 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 illustrates greater consensus than is found in cotton.

Farmers must cultivate a more nuanced knowledge in their rice seeds and practice that knowledge when selling rice seeds at the market. "Smart farmers keep the harvest and sell when the price is high if they can," explained one Ralledapalle farmer. "[One should watch for] 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." Planting one *beriki* seed will produce uneven grains that are less desirable to buyers in seed markets. Because farmers and rice buyers prize the same qualities in their rice plants, including colour, weight, moisture content, and overall plant health, farmer knowledge pays dividends in the field and in the marketplace.

Unlike cotton, the rice crop is not a commodity that might originate from anywhere, producing a second commodity that might be destined for any location (van der Ploeg, 2010). Rather, it has identity and personality, understood through deeper set of knowledge and practices beyond that seen in branded cotton seeds. In 2016, 71% of Warangal farmers we surveyed who planted rice reported saving at least some seeds to eat them, replant them, or usually both. On average, farmers who saved seeds saved 75% of their total yield (median = 100%), whereas farmers as a whole saved slightly more than half of their yield (median = 50%). Farmers of all castes and landholding sizes saved their seeds to eat or replant them in 2016, with the largest 20% of farmers by landholding saving about 45% of their yields on average and the smallest 20% of farmers saving about 49%. Where our previous work has shown that ST and Telugu caste farmers make different kinds of decisions about cotton seeds, we did not find similar spatial differences in rice seed choice or differences in rice seed saving across ethnic lines. However, the percentage of seeds saved varied by village, with far fewer (less than 10% in 2016 and 2015) seeds saved in Kavrupad than the others. We suspect that this has less to do with ethnicity, although Kavrupad is a Telugu caste village, than with Kavrupad's local rice mill, owned by a prominent and well-liked family who provide an easy way to process and sell rice seeds. Unfortunately, we do not have data on how much of the household rice production was consumed in the

TABLE 2 Rice novice plantings in 2012–2015 (n = 750)

	Rice seed choices	Percentage of total seeds
Novice	151	20.1
Repeat	599	79.9

household versus saved for the following year's production. However, seed saving as a general practice cuts across the entire diverse farming community.

This does not necessarily mean that other aspects of rice agriculture, such as the common practice of herbicide use, fertilizing, or machine plowing are not commodified. Stone and Flachs (2017) have shown how herbicides commodify one element of crop management that changes the management practices for commodity cotton farmers. Rather, it suggests that the degree and nature of commodification for a crop can be distinguished from the commodification in the tools used for its production. In this way, the rice crop is only partially commodified. Where specific information about fertility or pest management is often purchased, farmers appear to retain a good deal of indigenous technical knowledge regarding the seeds themselves.

Even when the rice crop is destined exclusively for a marketplace, rice knowledge remains more intact because growers and buyers use similar bodies of practice to evaluate their seeds. Unlike cotton agriculture, where seed knowledge has become the purview of experts and merchants outside of the farm household, the knowledge of seed selection and valuation remain vested in farmers who work with them. Both farmers and market-based buyers use their eyes, hands, and tongues to test rice seeds for their durability, taste, colour, and starch content. These qualities are equally valued by farmers looking for high-performing seeds and by grain buyers looking for any excuse to mark down the price of seeds. Farmers identify high quality seeds and thin out undesirable seeds to secure a large harvest that can be saved for future planting, but those same seed qualities pay dividends at grain markets.

When the time comes to harvest seeds, the entire family may join hired labour to inspect their rice plants. “You can keep saving and replanting until the backbone (the plant's seed bearing ear) becomes weak and sags”, advised one Ralledapalle farmer. After the rice has been collected, winnowed, and bagged, farmers determine how much to save beyond the minimum they need to sell to recoup their losses and gain a profit. In all cases, farmers must make decisions about their seeds based on their particular situation at that time, not seeking to maximize yield so much as reliability. It is useful to do “well enough” with rice seed, where seed saving, taste, and reliability are just as important as profit and yield. Because it can be eaten or sold, it requires nuanced local knowledge about seeds and land qualities, and it often relies on reciprocal labour networks, rice agriculture looms large in literature problematizing the commodity (Glover & Stone, 2017; Maat, 2016; Richards, 2016). This can be contrasted with Telangana cotton cultivation, where the goal is always to produce as much as possible of whatever has value in the market. The important factors of rice cultivation are thus highly consistent in the minds of individual farmers and dependent on their personal needs—even when they purchase fertilizers or pesticides from merchants.

Due to the complex ways that practice, knowledge, commercial inputs, and seeds are intertwined, rice is a semi-commodified crop on our spectrum. Rice lacks the unrecognizability, fast-paced change, and inconsistency described in the Indian cotton sector. The qualities bred into OPV rice under controlled situations persist when such seeds are replanted, relegating the profits of seed selection back to farmers rather than to seed company investors. At seed shops, rice choice is a selection between fewer than three dozen options, based in optimizing management costs, yield, taste, and the seed's ability to be saved. Neighbours, shops, and extension agents have a noticeable but diminished influence on farmers' choice of rice seed varieties. This partial grasp on the labour, inputs, and knowledge of production help to keep rice only partially commodified, and so rice seeds are understood as things with social lives rather than as alienated, branded commodities purchased in service of the production of a new commodity. This association between knowledge and commodification has implications for both the growing hybrid rice market and the vegetable and flower plants that farmers regularly plant in field gaps.

4 | KNOWLEDGE AND EXPERTISE IN HYBRID RICE AND COMMON GAP-FILLING PLANTS

OPV rice accounts for 87% of the rice seed choices in our sample. The other 13% is accounted for by a growing market for hybrid seeds. Like cotton seeds, they are more flamboyantly branded and sold as a cash crop rather than

eaten. Bought by farmers who have scant knowledge of their specific properties, they are purchased as a new product each year because of their acknowledged reliability from a public breeder. Thus, does agricultural knowledge simplify in tandem with the agronomic calculus for this rice seed—fewer considerations of taste, use, or reliability and more considerations of yield.

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," said one farmer, explaining his reticence. "Normally we use these local seeds, and all the seeds [respond] the same way." To woo farmers accustomed to chasing cotton yields but who value rice seed reliability, one company stationed a representative in a local municipality central to three of the villages where we work. This agent sells hybrid seeds but also rents out a labour-saving rice harvester. By working closely with farmers and renting out his harvester, the dealer built up a trust relationship that encouraged farmers, especially communities of Tribal Lambadi farmers who live in historically marginalized communities socially and spatially outside the Telugu caste majority villages, to switch to his seed.

Other farmers are considering a hybrid breeding rice locally called male/female rice, farmed under contract with multinational companies such as 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 strict regimen of soil tests, watering, and chemical applications so that they can produce viable hybrid seeds then sold to farmers 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 high-end biryani rice," suggested one farmer. Even a farmer boasting a master's degree in organic chemistry was at a loss, suggesting that the seeds were ground into powder and used to provide filler material for pharmaceutical drug capsules. This speculation is common in high-risk, high-return commodities ranging from coffee (West, 2012) to sapphires (Walsh, 2004), where distributors hold more power and know much more about consumer desires than producers.

Despite the cash benefits, farmers can find the high-risk, high-reward nature of hybrid rice agriculture exhausting. "A farmer will have one lakh (100,000) different kinds of problems," offered Yakub, the male/female planting farmer. Even though farmers can earn as much as six times the rate for hybrid breeding rice that they earn OPV rice, the frustrations of commodity rice 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 towards learning about more relevant information in hybrid rice—how to contact brokers, managing social connections to important resources such as insurance contracts or machinery, or staying afloat amidst the inputs and experts that dominate hybrid rice management. Knowledge of the seeds as things is not only externalized to brokers. Farmers also forfeit specific knowledge of how the seeds are used further down the commodity chain and lose track of the knowledge that tied them to the social life of the seed commodity.

Hybrid rice bridges the space between cotton and rice on a commodification spectrum. Hybrid rice is rarely eaten by the farmers who grow it, 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. No Warangal farmers in our study saved hybrid rice to replant it in the following year. 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 learn less about the environmental qualities of more commodified crops and more about how to buy products and follow expert instructions.

The opposite pattern can be seen with French marigold (*Tagetes patula* L.), pigeon pea (*Cajanus cajan* L. Huth), and tomato (*Solanum lycopersicum* L.) heirloom seed. Vegetables and flowers are grown almost exclusively from seeds

saved for aesthetic qualities important to the farmers themselves, are rarely bought or sold on the market but rather passed among friends and families, and lie on the opposite edge of the commodification spectrum from cotton. In Marxist terms, they are sustained largely for their use value, and attempts to exchange them more widely in a hypothetical marketplace would likely have negative effects on farmers' control over and relationship to seeds. These heirloom crops likely avoid commodification because they are marginal to farmers' market production, allowing for both more freedom in their cultivation and less economic anxiety if they should fail to produce. Farmers in this survey were seen to regularly sow economic plants ranging from vegetables to ornamentals to medicinal plants in gaps in their cotton fields where cotton failed to germinate (Flachs, 2015). The 161 farmers who planted these crops in 2014 replanted saved seeds from marigold, pigeon pea, and tomato for more than 7 years (Table 3) before choosing new seeds. Farmers reported that 17 of the 398 non-crop plants were hybrid varieties, whereas 364 were *desi*, indicating that they were heirlooms saved or bought from relatives or local vendors. No farmers planted novice seeds with which they had no experience. Branding is irrelevant in this context, where seeds are obtained mainly through local social networks or one's own stock. Rather than seeking out the most expedient way to transform commodities into new, profitable commodities, farmers choose seeds based on known aesthetic qualities or because of a personal connection to the grower. The labour and knowledge required to manage these crops are not hired, as in cotton, or reciprocally shared, as with rice, but practiced as a way to sustain relationships with relatives and friends who share seeds or to carry forward a favourite taste or colour from a vegetable or flower (Nazarea, 2014). For these plants, placed in parts of the cotton field where cotton had already failed to germinate, yield and profitability are entirely secondary concerns. The resulting harvest is almost never sold but is eaten or saved. Farmers plant marigolds both because they believe they will attract predator insects that attack crop pests and for their aesthetic beauty as part of floral displays at local festivals; tomatoes and pigeon pea are 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 and the qualities of pleasure, extravagance, taste, nostalgia, and bravado that they sought to cultivate.

The years of experience, lack of formal market interaction, farmer knowledge based in daily practice, and ultimate goal of the labour prevent these vegetable crops from becoming a commodity. They are rather understood as things with rich lives connected to specific management knowledge, family members, and friends. Their labour is neither obscured by the actions of corporate breeders nor is it masked by the commodity fetish. Instead, farmers maintain power and autonomy in almost all aspects of these seeds' production and consumption.

5 | KNOWLEDGE ACROSS THE COMMODIFICATION SPECTRUM

Seed choices are highly variable for Telangana farmers, reflecting a complicated set of knowledge, practice, and commodification. On Telangana farms, seeds are ultimately a vehicle for the larger agricultural systems of associated technologies, risk, the sociality of labour, and the knowledge that farmers can build on their farms. The relationship between knowledge, management, and different kinds of seeds fits the piecemeal adoption 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. The intersections of managers, knowledge, and seeds in different crops on Telangana farms can be depicted as the

TABLE 3 Years of experience with important non-commodity crops

	French marigold	Pigeon pea	Tomato
Average years planted by farmers before new seeds are bought	7.63	7.48	7.28
Total number of brands referenced by farmers	3	2	4
Novice plantings	0	0	0

commodification spectrum (Table 4). 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 is the purview of those external to the farming household, whereas farmers themselves are charged with being better accountants, marketers, and consumers of technology. Investments are high, necessitating high profits. Crops are managed in accordance with designs by off-farm scientists, weeded and harvested by hired labour, and fertilized and pest controlled by purchased inputs. Farmers bear the risks of losses and consider their crops as investments, hoping to increase profits at the expense of maintaining security or keeping local social ties. On the other extreme lie the wild, heirloom, or locally exchanged varieties of vegetables, trees, ornamentals, and medicines that farmers intercrop with their cotton or cultivate on field edges. The risks and profits of these crops are minimal, and their cultivation is only possible through seed exchanges, seed saving, and the ongoing selection of aesthetically pleasing, locally suited plants.

OPV rice lies in the middle of this spectrum, a semi-commodified crop with an elaborate social life nonetheless beholden to seemingly abstract market forces. 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. Experts, namely, rural shop owners, tend to be local and consulted only when it is time to buy new seeds, and farmers rarely consult experts at plant science stations. Farmers risk losing money on a bad harvest because of labour costs and chemical fertilizers, but their labour is also highly specialized to maintain their particular fields and reliant on labour exchange in addition to hired fieldwork. Farmer knowledge persists in rice for all the social and agricultural reasons that it fails to do so in cotton agriculture. 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.

When buying things created by private multinational companies in a laboratory and sold in a bewildering market, people generally and farmers in this essay surrender the conditions by which they learn about objects and apply that knowledge in the farm field. Variable degrees of commodification and commodity fetishism thereby constrain opportunities for knowledge by constraining opportunities for sociality, to the extreme that farmers can become deskilled because of one seed market even while they maintain nuanced skill in other crops and crop markets. By placing these crops along a commodification spectrum, we emphasize the connections between commodification and the conditions under which one can create knowledge. Maintaining control over germplasm as rice seed savers and heirloom planters is an important way to build skill and thus make agro-economic decisions. This kind of knowledge has persisted in rice agriculture not only because of the inherent biology of OPV rice but also because that rice is

TABLE 4 Crop knowledge and the commodification spectrum

Less commodified				More commodified
Knowledge more intimate				Knowledge less intimate
Yield less important				Yield more important
Branding less important				Branding more important
Crops	**Heirloom vegetables, medicinals, flowers**	**OPV rice**	**Hybrid rice**	**Hybrid GM cotton**
Average years planted per farmer	7.46	4.66	1.51	1.77
Branding	91% *desi* (heirloom)	Station/hybrid number	Brand names	Brand names
Brands referenced by farmers	4	30	33	113
Role of experts	Negligible	Consulted intermittently	Brokers consulted	Shops, brokers consulted
Saving	Almost always	Often	Rarely	Never

Note. GM: genetically modified; OPV: open pollinated variety.

embedded in a social system that allows farmers to benefit from the same qualities that they sell in the market. The cotton seed choices, defined by an all-encompassing need to achieve high yields, incentivize farmers to go to extreme lengths that put them at risk for fake seeds and ruined seasons. As seed companies continue to expand hybrid or GM hybrid seed opportunities, crops will continue to move right on the commodification spectrum, further replacing local knowledge with brands sold by experts.

ACKNOWLEDGEMENTS

The authors are grateful to the Jacob K. Javits Fellowship Program, the National Geographic Society Young Explorers Grant 9304-13, the Volkswagen Foundation, the National Science Foundation Grant 0314404, and the John Templeton Foundation for funding this research, and all opinions expressed are our own and do not necessarily reflect the standpoints of these organizations. Ranjith Nakka Kumar and Arun Vaynala Kumar provided valuable research assistance, Ram Mohan Rao and Vandita Rao provided indispensable logistical help in India, two anonymous reviewers provided helpful comments, and James Babbitt provided useful comments on a draft of this paper.

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How to cite this article: Flachs A, Stone GD. Farmer knowledge across the commodification spectrum: Rice, cotton, and vegetables in Telangana, India. *J Agrar Change*. 2018;1–21. https://doi.org/10.1111/joac.12295

APPENDIX A. 2014 COTTON KNOWLEDGE CONSENSUS AS % OF ROW TOTAL (*N* = 401 SEED CHOICES)

	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

Note. DNK: do not know.

APPENDIX B. 2014 RICE KNOWLEDGE CONSENSUS AS % OF ROW TOTAL (*N* = 178 SEED CHOICES)

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

Note. DNK: do not know.