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Rhythms of the herd: Long term dynamics in seed choice by Indian farmers

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ABSTRACT

Scholars in many disciplines have approached the question of how humans combine environmental learning (or empirical assessments) and social learning (or emulation) in choosing technologies. As both a consumer item and the subject of local indigenous knowledge, commercial crop seeds provide a valuable window into these processes. Previous research on seed choices by cotton farmers in Andhra Pradesh, India, uncovered short-term seed fads, or herding, indicating agricultural deskilling in which environmental learning had broken down. Unknown was if the faddism (and the underlying deskilling) would continue or even be exacerbated by the spread of genetically modified seeds. Data covering 11 years of seed choices in the same sample villages are now available; we combine analysis of this unusual data set with ethnographic observation. We find that herding has continued and intensified. We also find an unexpected emergent pattern of cyclical fads; these resemble classic models of successive innovation adoption where periodicity is introduced from outside the system, but we argue that it periodicity is actually generated by an internal dynamic.

1. Introduction

For farmers, says a recent book on the wisdom of crowds, "choosing the right variety… is the most important decision they can make, so it's perhaps not surprising that they would make those decisions on their own, rather than simply mimicking those who came before them" [1]. On the importance of seed choice there can be no argument, but the relationship between individual decision-making and mimicry is not so simple. Seeds naturally pose special challenges to the farmer as experimenter, particularly because they have vital qualities that become apparent only over time or under special circumstances [2].

India's cotton farmers provide a particularly interesting – if also troubled – case study in decision making on seeds. India is the world's biggest cotton planter and has some of the world's lowest yields; debt and crop failure have been linked to cotton farmer suicides [3,4]. Although the most lucrative cash crop for many, cotton is also a notoriously unreliable earner because it is input-intensive, vulnerable to numerous pests, and sensitive to market fluctuation. Seed is usually repurchased on the market every year since most Indian cotton is hybrid, and the cotton seed market is unreliable, offering hundreds of rapidly-changing and often deceptively-labeled seed brands [5]. Seed choice has been further complicated by successive introductions of transformative technologies since the 1990's: the spread of hybrid seeds, followed by several waves of insecticide technologies, followed by genetically modified (GM) Bt

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cotton seeds [6,7].[1] The Bt seeds have brought a wave of controversy as well as a quickening of an already dizzying pace of technological change, from three seed brands containing a single transformation event in 2002 to six different events, sometimes stacked in various combinations, in over 1000 seed brands.

Farmers must navigate these kaleidoscopic conditions in markets, technologies, and agroecology as they select seeds that vary in cost, in desired time to harvest (which affects labor mobilization and credit management strategies), in number and size of bolls (which impacts harvesting costs), in water requirements (in a region with fickle monsoons and unreliable irrigation), and in insect resistance (in an area with a dozen major cotton pests).[2] Insight into how farmers go about choosing seeds under these conditions may be valuable in building theory on indigenous technical knowledge and on evaluation and adoption of technology; it may also be of practical relevance to our understanding of effects of GM technologies in developing countries, as the debates on this in India invoke claims about the farmer's ability to assess the new seed technology. GM seed advocates have argued both that the Indian farmers who adopt GM seeds are too smart to be second-guessed, and that GM seeds are suited to developing-world farmers who just cannot be taught.[3]

Technology adoption has been modeled in very different ways over the years by several disciplines [10,11]. But running through the diverse literatures is the recognition of two fundamental human strategies of choosing technologies. The first involves some form empirical assessment of the benefits of the technology (often called "payoff information"); the second involves emulating others. These basic strategies go by many names, including environmental and social learning (or cultural transmission) [12], and innovation and imitation [13]; for a review see Conley and Udry [14]. For simplicity we will term them *the better mousetrap* and *the copycat*.

Implicit in the *better mousetrap* strategy is that a new technology (or a new variant of an existing technology) may outperform extant technologies, and that its superiority is discernible by users: the farmer sees that the seed produces more crop, the computer maker sees that the microprocessor runs faster, the physician sees that the antibiotic cures more bacterial infections. However in practice, technologies vary enormously in *trialability* – how well they lend themselves to empirical evaluation through use. Literal mousetraps are on the "trialable" end of the continuum; on the other hand, many agricultural technologies are very difficult to trial under actual farming systems. Breeding of crop seeds relies heavily on field trials, but these are conducted under highly artificial conditions [15].

The *copycat dynamic* refers to the common practice of basing technology use decisions on others' decisions. Copycat decisions are based on who is (or how many are) using the technology, rather than how well the technology is working for them. Humans copy each other in matters both grave and frivolous, often picking our models on social criteria that may have nothing to do with how well the technology works.[4] Terms for emulation, including *copycat* and the verb *to ape* [17], have negative connotations, but emulation is a fundamental and indispensable practice in a species adapted to such a wide range of practices and habitats [14]. Patterning in copycat decisions may lead to the emergent phenomenon of *herding,* defined here as widespread conformity that is not obviously adaptive. Wearing warm clothes in winter would not be considered herding because it is clearly adaptive; young people specifically wearing Ugg boots would [cf. 18].

Our long-term investigation of decision-making among farmers in Warangal District, Andhra Pradesh, has generated an unusual dataset on seed choices. Previous publications on the early years of the study showed a striking pattern of herding or seed faddism. Defying social science dogma (and biotech industry rhetoric) about farmer technology adoption being based on careful experimentation, Warangal farmers were found to routinely plant seeds about which they knew very little, often abandoning a seed before planting it long enough to learn much about its performance. Ethnographic investigations showed the underlying cause to be hyper-reliance on *copycat* emulation due to severe impediments to *better mousetrap* trialing. Stone [5,19] used the case to theorize agricultural skilling and to identify the three causes of agricultural deskilling as inconsistency, unrecognizability, and accelerated technological change. Genetically modified seeds were adopted during the early years of this study, with the promise of alleviating the severe attacks of Lepidopteran (caterpillar) pests. But seeing the pest-induced losses as a symptom of larger problems, Stone asked if the new round of technological change could alleviate symptoms at the expense of exacerbating the underlying cause. Since deskilling had earlier been revealed in seed choice patterns, further data on seed choices have been collected as Bt seeds have spread.

We report here on a unique dataset on seed choices spanning 11 years, along with extensive ethnographic detail on the dynamics of decision-making. This body of

[1] GM plants are made by exposing target cells to a vector containing DNA from disparate sources. After exposure, target cells are screened to isolate the cases in which the DNA has been integrated into the target cell's genome. Each case is termed a *transformation event*, or simply an *event*. Each event is unique, sensitive to where and how the introduced DNA is integrated. Once an event has been isolated and evaluated, the cells are cultured and grown into plants so that it can be introduced into various crop varieties by conventional breeding. Bt is *Bacillus thuringiensis*, a soil bacterium. Proteins expressed by its "Cry" genes are toxic to some Lepidopterans that are common cotton pests.

[2] This list of considerations is far from complete. For instance, some seeds have systemic problems such as failure to germinate, and farmers are sometimes given government-mandated rebates. Some brands turn out to be non-viable "spurious seed," which can be ruinous, and some seeds are available only through the black market, which leaves the farmer without a receipt needed for recompensation.

[3] Agriculture minister Sharad Pawar asserts that the Indian farmer has adopted GM seeds and that "The farmer is wiser than me" [8]. On the other hand, biotechnologist Martina McGloughlin claims "for years people have tried to change cultural practices of these farmers, and it just hasn't worked. It has been a complete failure, because … you have to re-educate them as to how to modify their farming practices themselves. But with biotech, the technology is in a seed. All you have to do is give them the seed" [9].

[4] Francis Galton referred to the "mindless gregariousness of herd animals" [16]. But of course herd animals are not at all mindless – they are of a very firm mind to conform to the behavior surrounding them, which is adaptive, in contrast to "mindful" idiosyncratic behavior which may be maladaptive.

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