FARMER FIELD DAYS AND DEMONSTRATOR SELECTION FOR INCREASING TECHNOLOGY ADOPTION

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Abstract—Inadequate learning is an oft-cited friction impeding the adoption of improved agricultural technology in the developing world. We provide experimental evidence that farmer field days, an approach used throughout the world where farmers meet, learn about new technology, and observe its performance, alleviate learning frictions and increase adoption of an improved seed by 40%. Further analysis demonstrates that these field days are both cost-effective and have a greater impact on poorer farmers. In contrast, we find no evidence that selecting the first adopters of new technology in participatory village meetings has any effect on future adoption.

I. Introduction

TECHNOLOGY is an important engine of growth for smallholder farmers in developing countries. Yet, adoption levels often remain below expectation, with slow learning serving as one of the common explanations (Jack, 2011). Agricultural extension is the most common technique in developing countries for transferring technological information from scientists directly to farmers. Optimizing extension services requires building a better understanding of the effectiveness of different methods for spreading and aggregating information. Recent work has considered the potential of sharing advice via mobile phones (Aker, 2011; Fafchamps & Minten, 2012; Cole & Fernando, 2018), improving the selection of the "seed farmers" chosen as the first users of technology (Beaman et al., 2018), or compensating these initial seed farmers based on future adoption in the community (BenYishay & Mobarak, 2018).

We offer experimental evidence on a different approach known as the farmer field day, where a new technology is introduced and tested by a group of "seed farmers" and then an NGO or extension worker engages neighboring farmers in a meeting where the attributes of the technology are discussed, and its performance is observed in the field. The field day creates an opportunity for farmers to share information, observe performance, and deliberate on technological attributes. This approach contrasts with relying only on informal communication among farmers in networks. Despite this technique being common, we have limited knowledge on its effectiveness.[1]

We also investigate whether the effectiveness of field days depends on how seed farmers (whom we refer to as demonstrators) are selected. Peers serve as credible sources of information about agricultural technology (Foster & Rosenzweig, 1995; Bandiera & Rasul, 2006; Conley & Udry, 2010; Krishnan & Patnam, 2014). Building on this, recent literature focuses on how to optimally select demonstrators. The methods considered range from selecting lead farmers or more representative peer farmers, or eliciting the full social network and selecting the theoretically optimal demonstrators (Kondylis, Mueller, & Zhu, 2017; BenYishay & Mobarak, 2018; Beaman et al., 2018).

We test whether selecting demonstrators via village meetings improves learning and increases adoption. We consider this approach for three reasons. First, selection by village participation, in contrast to selection by local village politicians, has the potential to increase adoption by generating a more representative pool of demonstrators, which can improve social learning by making it easier for farmers to extrapolate the outcomes of demonstrators to their own situations (Conley & Udry, 2010; BenYishay & Mobarak, 2018). Second, the low cost of meetings makes them a policy-relevant alternative. Third, if villagers know the best people to diffuse information, as in Banerjee et al. (2019), then village meetings may be a simple way of getting them to combine this information.

In the first arm of our experiment, we introduced 25 kilograms of a new high-yielding and flood-tolerant rice variety, Swarna-Sub1, in 100 villages in Odisha, India. Importantly, the technology dominates existing technology, indicating that it should diffuse rapidly in the absence of barriers to adoption.[2] The farmers receiving seeds, that is, the demonstrators, were chosen using one of three methods. In one-third of the villages, we used the status-quo approach of delivering the seeds to locally elected village officials—ward members in the Gram Panchayat—who then chose how to further distribute the seeds among villagers.[3] In another third of the villages, we used a participatory meeting where villagers were

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[1]The field day is commonly part of the "farmer field school" approach where the first users of the technology also receive frequent trainings on the technology throughout the season. The field day, where other farmers are invited to observe the experimentation, happens at the end of the season. We focus only on the field day as a way to decrease the cost of the intervention and thus increase scalability.

[2]The variety was released in 2009. It offers flood tolerance without reducing yield during nonflood years (Dar et al., 2013). The technology also leads to significant welfare gains by inducing farmers to modernize production (Emerick et al., 2016).

[3]The method of delivering a small amount of seeds for testing and knowledge creation is a popular approach in South Asia. India's National Food Security Mission (NFSM) program uses these seed minikits and relies on members of the Gram Panchayat to help identify beneficiaries.

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invited to jointly determine how the seeds should be allocated. Finally, we used village meetings with local women's groups (self-help groups, SHGs) in the remaining villages.

In the second arm of the experiment, our partner NGO carried out the farmer field days in fifty villages. These field days occurred approximately four months after the seeds were introduced and while the crops of the demonstrators were nearly mature. The field days were simple two-hour events where the NGO gave information on the new variety, demonstrators spoke about their experience, questions were answered, and then attendees were taken to observe the crops in the field.

We then measured demand directly by offering the new variety for sale after harvest and immediately prior to planting for the next growing season. The sales teams went door-to-door and asked a random sample of fifteen households per village whether they were interested in buying seeds. Importantly, we fixed the price to be near the prevailing market price.[4] Door-to-door sales have two main advantages. First, they reveal demand at the market price in the absence of any barriers on the supply side. Second, self-reported information on seed variety adoption is known to contain significant measurement error (Macours, 2019). Directly revealing behavior, rather than relying on self-reports, minimizes this error.

The experiment delivers three main results. First, the field days lead to an economically significant increase in uptake. In particular, field days caused uptake to increase by 12 percentage points, or from 30% to 42% of farmers. This effect is larger for adoption of a single-seed package: purchases of one 5 kilogram packet rose by 59%, while purchases of at least two packages rose by only 25%.[5] Importantly for policy, this technique is cost effective. Field days deliver a return on investment after just a single season of about 1.14. Moreover, the effect of field days on demand is the largest for poor and historically disadvantaged farmers. More specifically, the treatment effect is significantly larger for farmers in lower caste groups and farmers below the poverty line (BPL), as defined by the government's antipoverty program.

Second, despite reducing favoritism by elected officials, selecting demonstrators via meetings had no impact on adoption. Differences in adoption between ward member, SHG meeting, and village meeting villages are small and statistically insignificant. In general, we can rule out large effect sizes comparable to those of the field days. This null effect exists despite the fact that meetings alter the pool of demonstrators. Elected officials tend to favor their close friends when selecting demonstrators. This favoritism disappears when selection takes place during meetings. More concretely, the demonstrators are 31% and 62% less likely to be close family or friends of the ward member in village meeting and SHG meeting villages, respectively.

Third, the effect of field days is no larger when demonstrators are selected by meetings. If anything, the effect is largest when demonstrators are selected by locally elected officials. However, the differences in treatment effects across the three methods of identifying demonstrators are not statistically significant. Nonetheless, we can rule out large and positive interaction effects between the field days and village participation in selecting demonstrators. We interpret these findings as evidence that the field days enhance learning and increase adoption, regardless of the identities of the demonstrators.

We close by presenting suggestive analysis to investigate some possible mechanisms for the field days. The data suggest that field days do more than inform farmers about the existence of the new technology. Most farmers in the control group are aware of Swarna-Sub1. Moreover, the field days have an impact for the demonstrators, who were clearly already aware of the technology. We also show that the field days did not seem to be more effective in villages with more demonstrators or when they were attended by more demonstrators. We conclude from these findings that the effectiveness of field days may not result from greater communication between demonstrators and farmers. This leaves potential alternative explanations, such as that farmers benefit from hearing from an outside NGO or other farmers.

We contribute by providing some of the first experimental evidence on field days as a technique for encouraging technology adoption. Field days are commonly used throughout the world. They are a standard element of the farmer field school approach where multiple trainings are carried out over a season and the field day takes place at the end to explain the demonstration and share information to a wider set of farmers. This approach to agricultural extension has been implemented in at least ninety countries, yet rigorous evidence on its effectiveness remains scarce.[6] Two recent experimental studies find little evidence that field days lead to cost-effective gains in adoption. Maertens et al. (2021) find that field days had no effect on learning and adoption of techniques to improve soil fertility in Malawi. Relatedly, Fabregas et al. (2017) find in Kenya that field days had large (but insignificant) effects on adoption of soil amendments and were not cost effective. The field days that we study differ from these two papers. First, the field days in our experiment had a narrowly focused message on a particular new seed variety. This may be easier to learn about in a field day compared with a complex bundle of practices or a new input with

[4]The new variety was not yet available at the government offices where most farmers purchase subsidized seeds. One company in the area was selling seeds of this variety at a price higher than the subsidized price. We refer to this as the prevailing market price.

[5]Ninety-seven percent of farmers who purchased seeds bought only one or two packages. This amount of seeds is enough to cultivate around 10% to 40% percent of their land.

[6]Waddington, White, and Anderson (2014) provide a comprehensive review of the literature on farmer field schools. They found no randomized evaluations of field schools. The vast nonexperimental literature tends to find that field schools increase adoption and improve outcomes of participants but result in little diffusion to others (Godtland et al., 2004; Feder, Murgai, & Quizon, 2004; Ricker-Gilbert et al., 2008; Davis et al., 2012; Larsen & Lilleør, 2014; Waddington, White, & Anderson, 2014).

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heterogeneous returns. Second, these field days were smaller (carried out at the village level) and less costly.[7]

We also add to a literature that investigates policy-relevant mechanisms for improving the selection of demonstrators. These mechanisms aim to identify the optimal entry points for diffusion of information between agents in a social network. As one example, Beaman et al. (2021) find that theory-based methods of selection outperform selection by Malawian extension agents. Specifically, their model-based treatments cause increases in adoption of an improved planting technique by around 3 to 4 percentage points. The costliness of collecting network data makes that particular treatment difficult to implement but suggests the need to find more scalable, but no less effective, alternatives to identifying contact farmers. Participatory meetings with villagers seem like a desirable alternative because they are inexpensive and villagers may have private information on the people best positioned for information diffusion (Banerjee et al., 2019). We find no evidence that this selection mechanism drives adoption. Instead, farmers gain additional useful information from meeting to discuss a new technology.

The rest of this paper is organized as follows. Section II provides background on the Swarna-Sub1 technology and discusses the experimental design. Section III discusses the conceptual motivation for this experimental design. Section IV gives results, while section V offers concluding remarks.

II. Background and Experimental Design

This section provides details on the technology introduced to farmers, emphasizing how its properties make it a suitable technology for studying diffusion. We then give specific details on the experimental design.

A. Swarna-Sub1 Technology Introduction

Swarna-Sub1, a rice variety released in India in 2009, offers flood tolerance as its unique benefit. Swarna-Sub1 remains otherwise similar to Swarna, a popular type of rice cultivated throughout eastern India and Bangladesh. The technology was developed by moving a group of flood tolerance genes from a traditional rice seed into Swarna.[8] Plant breeders were able to rely on modern breeding techniques to create the improved variety without introducing other undesirable characteristics, such as lower yield during normal years or inferior eating quality (Xu et al., 2006). This is important because it guarantees that the technology offers an added benefit but otherwise remains similar to a well-known seed variety.

Previous work has conferred two channels through which this new variety improves welfare. First, the technology increases output under flooding without lowering it during normal years (Dar et al., 2013). Second, Swarna-Sub1 induces farmers to invest more in inputs, particularly at or near the time of planting — likely due to the reduction in risk they face (Emerick et al., 2016). Thus, adoption can induce welfare gains even absent flooding.

This innovation offers a unique opportunity to study diffusion because it dominates an existing and common seed. At the same time, there are few differences between Swarna and Swarna-Sub1 other than flood tolerance. This simplifies learning because the innovation offers value without requiring farmers to learn about other new inputs or management techniques. This suggests that the technology should diffuse rapidly in a frictionless environment. We focus on learning frictions and show them to be one potentially important barrier to adoption.

B. Details of the Experimental Design

The experiment took place in 100 villages in Balasore, a district in the northeastern corner of the state of Odisha, India.[9] The villages are located in three blocks—an administrative unit two levels above villages. We randomly selected these villages from the subset of villages that were affected by flooding for at least two days in 2011 or 2013, as measured from satellite images. The sample focuses on flood-prone areas to ensure that adoption is a profitable outcome.

We next describe the timing of events, which we also display graphically in figure 1. We first administered a baseline survey to ten farmers in each village.[10] A local village leader identified these farmers for our survey teams. The baseline aimed to measure whether farmers in the sample villages had any experience with Swarna-Sub1. Past experiences were indeed limited: only two of the farmers surveyed had cultivated Swarna-Sub1 during the previous season. In contrast, 74% of farmers were cultivating Swarna, the variety that is otherwise similar except for flood tolerance. This makes the technology ideal for the experiment because it is profitable relative to the most popular variety but unknown to farmers, making learning about its benefits an important consideration.

Shortly after completion of the baseline in May 2014, enumerators returned to all villages, regardless of treatment status, to distribute seeds to demonstrators. Each village was provided with 25 kilograms, an amount sufficient to cultivate 1 or 2 acres. More important, the seeds were already packaged into 5 kilogram packages to encourage at least five farmers to be selected as demonstrators.

Villages were randomly assigned to one of three methods for identifying demonstrators. First, the seeds were delivered to the locally elected village ward member in 33 villages. The ward member is elected to represent the village in the local Gram Panchayat, the next administrative unit above villages.

[7]Fabregas et al. (2017) report cost estimates of around \$9 to \$26 per attendee. The field days in our experiment cost about \$5.58 per attendee.

[8]The biological mechanism is that Swarna-Sub1 suppresses the plant's natural response of elongation during flooding. This allows the plant to retain the necessary carbohydrates for regeneration after the flooding (Voesenek & Bailey-Serres, 2009).

[9]See figure A1 for a map of the study area and villages.

[10]Enumerators were unable to carry out the baseline survey in one of the 100 villages.

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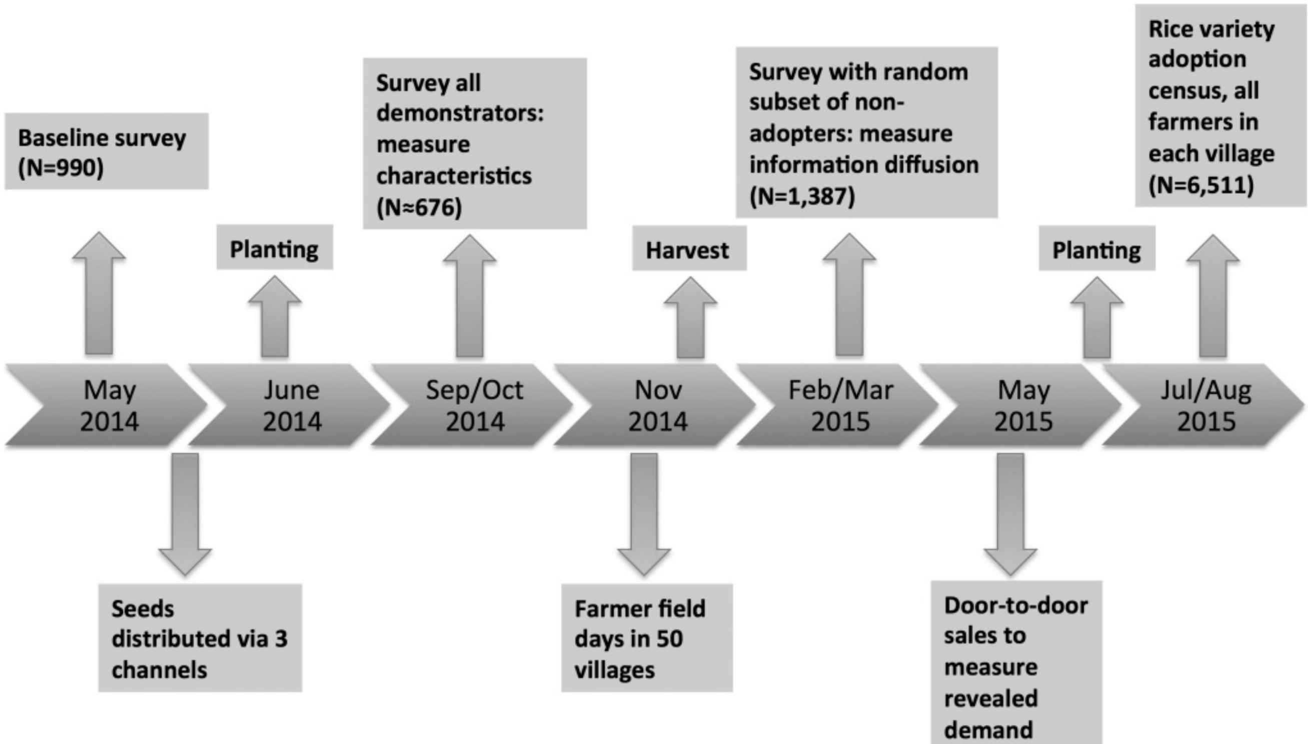
FIGURE 1.—TIMELINE OF THE EXPERIMENTAL DESIGN



The figure shows the timing of the activities that were carried out as part of the experiment. Planting for each season occurs in June, and harvesting generally occurs in late November to December.

A representative from our partner NGO delivered the seeds directly to the ward member and said that the NGO was giving the seeds to the village. The enumerator then instructed the ward member to pick demonstrators so that after a year, a lot of farmers will be able to grow Swarna-Sub1 in the village. This guidance encourages the ward member to select demonstrators with village-level adoption in mind. The seeds were then left to the ward member, and she independently decided on their further distribution, including whether to keep some for herself. This approach simulates the common approach of both government and NGOs of using local political figures to distribute seed minikits, as in Bardhan & Mookherjee (2006, 2011).

Second, in 34 meeting villages, NGO staff first visited the village and informed as many villagers as possible that they were carrying out a short meeting to describe a new flood-tolerant rice variety. Enumerators were specifically instructed to put the seed minikits at the front of the meeting and describe the benefits of the new variety relative to Swarna. Importantly, enumerators instructed villagers to jointly decide on demonstrators, again with the idea of maximizing future adoption at the village level. In all cases, villagers were able to come to an agreement, and all 25 kilograms of seed were distributed to farmers who were willing to plant.

Third, we used a process that was nearly identical to the meetings in the remaining 33 villages—the only difference being that only self-help group (SHG) members were invited to the meeting. All group members were women.

Enumerators returned to all villages in September 2014 to survey the demonstrators. This short survey had two purposes. First, it allows us to compare characteristics of demonstrators across treatment arms. Second, we collected information on how much area was planted with Swarna-Sub1, the current status of the crop, and the GPS boundaries for the plots of farmers who actually transplanted the seedlings. Overall, we have plot locations for 452 (67%) of the farmers who received seeds.

Farmer field days were then carried out in fifty randomly selected villages during November 2014. The field days were purposefully timed to take place slightly before harvest when the demonstrators had built some experience with the technology but the crop was still in the ground for demonstration.[11] The field days were short. The protocol included a period at the beginning where the NGO introduced farmers to Swarna-Sub1, its main flood-tolerance benefit, and its similarities with Swarna. Farmers were shown pictures of head-to-head comparisons between Swarna and Swarna-Sub1 after flooding. The NGO facilitator then gave farmers some brief information about management practices, including the time of planting, seeding rate, fertilizer requirements, and pest control. After this, the facilitator explained practices that can be taken to ensure proper seed quality. These practices are not specific to Swarna-Sub1 but relevant for any type of rice

[11] Demonstrators did not know the field days would eventually take place when they were provided seeds.

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variety. The demonstrators were then given an opportunity to share their experience with Swarna-Sub1. Other than this, the field days were led by the NGO facilitator. Finally, when possible, farmers were taken to a Swarna-Sub1 plot to observe performance.[12] The field days took about two hours.

The field days were attended by, on average, 41 farmers. This amounts to around 59% of rice-farming households in the village. Table A1 shows that household characteristics do not strongly predict attendance. The field days appear to have been attended by a broad group of villagers and not just the wealthiest or most elite farmers. In addition, we find no evidence that the types of farmers attending varied across the three methods for selecting demonstrators. In other words, farmers do not appear to be attracted to the field days based on their similarities with demonstrators.[13]

We carried out a survey with approximately fifteen farmers in each village in order to measure knowledge about Swarna-Sub1. We refer to this group as the nonadopting farmers—those who were not in the group of demonstrators. The surveys took place in February and March 2015. We used the list of households from the 2002 Below the Poverty Line (BPL) census to randomly select households.[14] We removed the demonstrators before randomly selecting the households. Each respondent was asked several questions to measure their knowledge of Swarna-Sub1. These included whether they knew about it at all, knowledge of its main benefit, which areas are suitable for cultivation, and duration (time from planting to harvest).

Our field partner sent a new team of staff members to each village in May 2015. Each farmer surveyed in February and March was visited and given the opportunity to purchase Swarna-Sub1 seeds. There was only one other NGO selling Swarna-Sub1 to farmers for a price of 20 rupees per kilogram. Our price was set to 20 rupees in order to mimic this market price. Thus, farmers benefited mostly from free delivery when given this purchasing opportunity. Most of the farmers in our sample did not know how to obtain Swarna-Sub1.[15]

We observed a strong demand for the technology in the door-to-door sales: 36% of farmers bought at least one package of seeds. Government seed dealers sold Swarna for a price of 14.5 rupees during the 2014 season. In Emerick et al. (2016), we estimate the profit advantage of Swarna-Sub1 to be around 1,800 rupees per hectare. Swarna-Sub1 is therefore still profitable with a price difference of 5.5 rupees per kilogram and an estimated seeding rate of 50 kilograms per hectare.[16]

The inability to record adoption from other sources, largely other farmers in the village, is the disadvantage of measuring demand with the door-to-door sales. Swarna-Sub1 is an inbred rice variety that can be multiplied, reused, and traded with other farmers. Many estimates indicate that this informal seed system of either reusing one's own seed or obtaining from neighbors accounts for a meaningful portion of seed supply in South Asia.

We remedied this issue by carrying out a door-to-door adoption census starting in July 2015. Survey teams went door-to-door in each village and asked each rice farming household a small set of questions, including whether they were currently cultivating Swarna-Sub1. A total of 6,511 households were surveyed. This additional data set allows for measurement of adoption for the same agricultural season as the door-to-door sales but from all possible sources, that is, not just from the door-to-door sales. The data show the importance of supply barriers. Only 14% of all households adopted Swarna-Sub1.[17] This compares to a 36% adoption rate in the door-to-door sales sample.

Table A2 shows summary statistics for the sample of fifteen farmers per village that we use in the analysis. The table also considers covariate balance by regressing each characteristic on the field day indicator and block fixed effects. Differences in means between the field day and control villages are generally small and statistically insignificant. Table A3 further verifies that household characteristics vary little across the three different methods of choosing demonstrators. Part of the reason we introduced only 25 kilograms was to make the pool of demonstrators a small share of the village. More concretely, around six to eight farmers, or 10% of the rice-farming population, were selected as demonstrators in most villages. Thus, the sample of nondemonstrating farmers represents most of the village. We also show adoption effects for the entire village, including demonstrators, which eliminates the possibility that any type of selection into the estimation sample affects any of the estimates.

III. Conceptual Motivation

Before turning to results, we briefly discuss the conceptual motivation of these interventions. Our experiment tests alternative ways to increase technology adoption. We consider alternative policy mechanisms to encourage learning—more specifically, interventions that can spread additional awareness, give farmers an opportunity to observe benefits, or let them hear from another source, the NGO in our context.

Along these lines, a field day serves as a way for farmers to learn about a new technology, hear the experiences of

[12] Farmers were not able to see plots if none of the demonstrators growing Swarna-Sub1 attended the field day. This happened 29% of the time.

[13] This could be because the NGO was responsible for inviting farmers to the field days or that farmers chose not to selectively attend based on the identities of the demonstrators.

[14] We selected all households in the villages where there were fewer than fifteen nonadopting households.

[15] One of the main questions that came up during the field days was how to obtain the seed. Private seed companies did not operate in this area at the time, and the seeds were usually not available at the local block office where most farmers buy their seeds. There was only one other NGO with access to seeds, and most farmers were unaware of this NGO.

[16] This seeding rate is larger than the agronomic recommendation, but more in line with what we observe in surveys.

[17] This figure includes the demonstrators from the previous year.

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demonstrators, and observe performance.[18] There are at least four mechanisms through which field days could increase adoption. First, information about the existence of Swarna-Sub1 diffuses imperfectly through networks. The field day causes knowledge about the existence of the new variety to diffuse to more people. As a result, some of these newly informed individuals adopt, increasing village-level adoption rates.

Second, beyond just learning that a new technology exists, farmers may not learn enough from demonstrators through normal social interactions. The ability to hear from multiple demonstrators or see their crops makes knowledge more precise and can increase the likelihood of adoption. One example would be a farmer who learns about the new variety from a demonstrator and thus possesses some signal of its effectiveness on her land. In this case, the field day might aggregate the experiences of other demonstrators outside this farmer's social network. If the farmer needs to observe the experience of more than one demonstrator to adopt herself, as in Beaman et al. (2018), then field days increase the likelihood of crossing this threshold by giving the opportunity to hear more from demonstrators.

Third, farmers may learn from demonstrators attending the field days, other farmers in attendance, or even the NGO staff. Fourth, physically verifying the main benefits of the technology might lead to greater adoption. Swarna-Sub1 looks visibly healthier than other seed varieties after flooding. Farmers may not notice this or may not observe the fields of demonstrators. The field day might induce farmers to actually observe this benefit, which could lead to more adoption.

In sum, there are multiple channels through which farmers may learn more at a field day. Disentangling these channels would provide useful insights for policy. For instance, field days might not be the cheapest policy tool if spreading awareness explains their effectiveness. Spreading awareness on a large scale could likely be achieved more cost-effectively by harnessing information technology. Or policy approaches to make field days more effective would depend on whether their efficacy is being driven by better learning from demonstrators or the NGO or extension agent. If the former, then subsidizing demonstrator participation might increase the benefits of field days. Our experiment does not allow us to perfectly tease apart these possible channels. We provide some analysis in section IVF that delivers suggestive evidence on which channels might be the most important.

Improved selection of entry points is an alternative policy mechanism for increasing adoption. The literature has considered different methods for identifying people who are best positioned to spread information in social networks. These methods span from asking a sample of villagers who is optimal for spreading information (Banerjee et al., 2019) to full elicitation of the structure of the village social network (Beaman et al., 2018). We borrow from the literature on targeting antipoverty programs to pose village meetings as an alternative for identifying demonstrators. This literature has found that villagers possess information on poverty status that is otherwise unobservable to a principal (Alatas et al., 2012). Does the same hold for information on the best entry points for new agricultural technology? Recent work by Banerjee et al. (2019) finds that Indian villagers are indeed effective at identifying people who are central for diffusing very simple information. Yet this may not imply that villagers hold the same information on who is best for demonstrating (through their actions of actually growing) and spreading information about new agricultural technology. Village meetings have potential if villagers both possess this information and are able to aggregate it effectively to identify demonstrators. An additional possible benefit of meetings is that farmers may learn better from similar individuals, particularly when returns to the technology are heterogeneous (Munshi, 2004; Tjernström, 2017).

Relying on locally elected officials to identify demonstrators serves as our benchmark. This method may offer its own advantages. Basurto, Dupas, and Robinson (2019) show that chiefs in Malawi account for productivity differences when allocating subsidized inputs to villagers. If the batch of demonstrators identified by local elites is more productive, then this could have positive effects for future diffusion. The ability of village participation to improve selection of demonstrators is therefore an empirical question with no strong exante prediction.

IV. Results

Section IVA shows how the different treatments affected awareness about Swarna-Sub1 and knowledge about its attributes. Sections IVB to IVD then show the main effects on technology adoption, including heterogeneous effects. We apply the treatment effects to impact estimates of Swarna-Sub1 in section IVE to show that field days are cost effective. Section IVF explores possible mechanisms.

A. *Treatment Effects on Knowledge*

Was there any measurable learning from the field days? Prior to the door-to-door sales, enumerators surveyed households to assess their knowledge of Swarna-Sub1. Farmers were asked several questions, starting with whether they had ever heard of Swarna-Sub1 and how many farmers they had spoken to about the variety. We then asked several multiple choice questions such as the two differences between Swarna-Sub1 and Swarna, the length of flooding that Swarna-Sub1

[18] A more passive approach would be to rely on informal communication through social networks to transmit this information. However, any model that requires farmer-to-farmer learning suffers from the reality that farmers gain little from sharing information with others, that is, demonstration and information-sharing create spillover benefits. This necessitates some method of encouraging the spread of information—direct incentives to demonstrators in the case of BenYishay and Mobarak (2018). In our case, the field day encourages the spread of information beyond what would have happened naturally in social networks.

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Table 1.—Effects of Field Days on Knowledge

	(1) Number farmers talked to	(2) Ever heard of Swarna-Sub1	(3) Difference with Swarna	(4) Pesticide requirement	(5) Available at block	(6) Maximum survival when flooded	(7) Most suitable land type	(8) Length of growing cycle	(9) Total correct 2–8
Field day	0.117*	0.056*	−0.038	−0.020	0.009	0.130***	0.058	0.068**	0.253*
	(0.064)	(0.030)	(0.042)	(0.053)	(0.054)	(0.045)	(0.039)	(0.034)	(0.136)
Village meeting	−0.045	0.050	0.033	−0.072	−0.045	0.079	0.020	0.020	0.086
	(0.079)	(0.038)	(0.054)	(0.064)	(0.066)	(0.059)	(0.044)	(0.043)	(0.181)
SHG meeting	0.035	0.062*	0.014	−0.035	−0.024	0.051	−0.020	0.024	0.088
	(0.079)	(0.035)	(0.046)	(0.061)	(0.062)	(0.054)	(0.048)	(0.043)	(0.159)
p-value village = SHG	0.33	0.66	0.71	0.57	0.76	0.59	0.41	0.91	0.99
Mean in ward villages	0.627	0.795	0.384	0.556	0.629	0.263	0.747	0.832	4.205
Number of observations	1,368	1,384	1,386	1,386	1,386	1,386	1,386	1,386	1,384
R^2	0.027	0.076	0.110	0.019	0.056	0.138	0.082	0.128	0.067

Data are for 1,387 households surveyed in between harvesting during the first season and planting for the second season. The dependent variables are as follows: Column 1 is the number of other farmers in the village talked to about Swarna-Sub1. Column 2 is an indicator for whether the respondent has ever heard of Swarna-Sub1 prior to the interview. Column 3 is an indicator for selecting both flood tolerance and husk color as the main differences between Swarna and Swarna-Sub1. Column 4 is an indicator for knowing that Swarna-Sub1 requires the same amount of pesticide as Swarna. Column 5 is an indicator for knowledge that Swarna-Sub1 is not available at the government block office (where farmers usually buy seeds). Column 6 is an indicator for knowing that knowledge that Swarna-Sub1 can survive up to two weeks when the field is flooded during the vegetative stage of the growing season. Column 7 is an indicator for knowledge that Swarna-Sub1 is most appropriate for medium land where flash flooding occurs. Column 8 is an indicator for knowledge that the duration (time from planting to harvest) of Swarna-Sub1 is approximately 140 days. Column 9 is the total number of correct responses in columns 2 through 8. All regressions include block fixed effects. Standard errors that are clustered at the village level are in parentheses. Asterisks indicate that coefficient is statistically significant at the ***1%, **5%, and *10% level.

can tolerate, and the duration of Swarna-Sub1 (days from planting to harvesting).[19]

Our simple specification measures the average effect of field days (across all three selection mechanisms), as well as the effects of selecting demonstrators with village and SHG meetings:

$$y_{ivb} = \beta_0 + \beta_1 Meet_{vb} + \beta_2 SHG_{vb} + \beta_3 FieldDay_{vb} + \alpha_b + \varepsilon_{ivb}, \quad (1)$$

where y_{ivb} is a measure of knowledge (or later adoption) for household i in village v and block b. The parameter β_1 measures the average treatment effect of using meetings for selection, relative to relying on ward members. β_2 similarly measures the effect of using meetings of women's groups. We first estimate the average effect of field days across all selection mechanisms with the parameter β_3. The analysis that follows considers separate impacts for the three types of selection. The villages in the experiment were spread across three blocks (an administrative unit, which was a stratification variable), and therefore we include block fixed effects. Finally, we cluster standard errors at the village level in all specifications.

Table 1 shows some modest effects of the field days on these observable measures of learning. Starting with column 1, farmers in field day villages report talking to an additional 0.12 famers about Swarna-Sub1, an approximate 20% effect. Column 2 shows that farmers are 6 percentage points more likely to have ever heard of Swarna-Sub1 in field day villages. However, this is compared to a fairly high base: almost 80% of farmers knew of Swarna-Sub1 in control villages. Knowledge on attributes of the technology in columns 3 through 8 are somewhat mixed. The strongest effect is in column 6, where field days led to an approximate 55% increase in knowledge of how long Swarna-Sub1 can survive when flooded. Column 8 shows that farmers in field day villages were slightly more likely to know the length of the growing cycle for Swarna-Sub1, although this effect is also modest because of high knowledge in the group without field days. Overall, column 9 shows that field days increased the number of total correct responses to the seven questions by about 0.25, or around 6%.

In contrast, the data show no evidence that participatory selection of demonstrators drives the spread of knowledge. The point estimates in column 2 show that awareness about Swarna-Sub1 increases by about the same amount as the field days. However, the remaining columns show no pattern of increased knowledge caused by the alternative modes of selection. Aggregating the number of correct responses in column 9 also shows evidence that the meetings did little to improve knowledge.

One possible explanation for the alternative selection methods not affecting results is that ward members select people similar to those selected during meetings. Table A4 shows that ward members were more likely to distribute seeds to themselves, their families, and close friends. Beyond this, the three selection mechanisms resulted in demonstrators with mostly similar socioeconomic and demographic characteristics. In other words, farmers selected by ward members are no less representative than those selected in the meetings. These similarities may explain why information transmits equally across treatments.

We find no evidence that the meetings were ineffective because they led to fewer demonstrators growing Swarna-Sub1. Despite having little effect on information diffusion, the meetings led to more demonstrators. Table A5 shows that village meetings increased the number of demonstrators and were over twice as likely to result in more than five

[19] In addition to flood tolerance, Swarna-Sub1 has a white husk, making it distinguishable from Swarna.

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TABLE 2.—EFFECTS OF VILLAGE SELECTION OF DEMONSTRATORS AND FIELD DAYS ON TECHNOLOGY ADOPTION

	(1) Buy	(2) Buy 5 KG	(3) Buy 10 KG	(4) Buy	(5) Buy 5 KG	(6) Buy 10 KG
Village meeting	−0.018	0.009	−0.027	−0.014	0.015	−0.029
	(0.057)	(0.049)	(0.038)	(0.057)	(0.049)	(0.038)
SHG meeting	0.008	0.004	0.004	0.009	0.012	−0.003
	(0.055)	(0.051)	(0.038)	(0.053)	(0.050)	(0.038)
Field day	0.122**	0.086**	0.037	0.120**	0.082*	0.038
	(0.047)	(0.043)	(0.032)	(0.046)	(0.042)	(0.032)
HH Controls	No	No	No	Yes	Yes	Yes
Strata FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean in nonfield day villages	0.297	0.147	0.150	0.297	0.147	0.150
Mean in ward villages	0.357	0.185	0.172	0.357	0.185	0.172
Number of observations	1,384	1,384	1,384	1,383	1,383	1,383
R^2	0.043	0.028	0.014	0.063	0.043	0.030

The dependent variable in columns 1 and 4 is an indicator for whether the farmer purchased Swarna-Sub1 when given a sales offer. The dependent variable in columns 2 and 5 is an indicator for purchase of one seed package (5 kg). The dependent variable in columns 3 and 6 is an indicator for purchase of at least two seed packages (10 kg). Household controls are indicator for ST (scheduled tribe) or scheduled caste (CS), indicator for BPL card, indicator for NREGS (National Rural employment Guarantee Scheme) job card, cultivated area, indicator for thatched roof, indicator for mud walls, education of the farmer, age of the farmer, indicator for SHG membership, indicator for private tubewell ownership, indicator for cultivating Swarna, and elevation of the household. Standard errors that are clustered at the village level are in parentheses. Asterisks indicate that coefficient is statistically significant at the ***1%, **5%, and *10% levels.

demonstrators being selected. Conditional on receiving seeds, table A6 shows that SHG demonstrators were less likely to transplant them, but uptake rates are similar between village meeting and ward member villages.[20]

B. *Treatment Effects on Technology Adoption*

Measuring adoption using the door-to-door sales, we find that selecting demonstrators with meetings had no effect on adoption. The average effects of village and SHG meetings in column 1 of table 2 are close to 0 and statistically insignificant. These null effects are moderately precise. The 95% confidence interval allows us to reject increased adoption from meetings of more than 9.56 percentage points, or around 27%. Similarly, we reject increases in adoption of over 11.75 percentage points (44%) from SHG meetings. Columns 2 and 3 show that this conclusion changes little when separately estimating effects for purchasing one or two packages of seeds.

This finding has implications for identifying demonstrators in agricultural extension. Village participation in this process does not lead to greater levels of adoption. BenYishay and Mobarak (2018) find that once incentivized, the identity of demonstrators matters for technological diffusion. In particular, more representative peer demonstrators increase adoption relative to lead-farmer demonstrators. In our case, other than connections to ward members, the demographics of demonstrators remain similar across our treatments. The lack of incentives to demonstrators may therefore be less relevant compared to the ability of ward members to select demonstrators who are not too unrepresentative of the average villager.

In contrast, encouraging information transmission via field days drives adoption. Focusing on column 1, the field days increased adoption by 12.2 percentage points. The rate of adoption across villages without field days was 29.7%. The point estimate therefore indicates that bringing farmers together to discuss a new technology leads to a 41% gain in adoption. Column 2 shows a larger effect on adoption of a single package of seeds. Adoption of just one 5 kilogram package increases by 8.6 percentage points—or 59%.[21] On the other hand, adoption of two packages increases by only 3.7 percentage points, and this effect is statistically insignificant.[22] Our data do not allow us to pinpoint an exact reason for this difference. Nonetheless, one possibility is that the field days provided additional information to farmers who were near the threshold of testing the new seed, but they had less impact for farmers who had already decided to plant the variety on a larger share of their land.

Figure 2 helps further understand this effect by showing the distribution of village-level adoption rates. Two things stand out. First, the field days decreased the frequency of little or no adoption at the village level. 35% of control villages had adoption rates lower than 10%. In contrast, only 12% of field day villages had such low adoption rates. Second, the distribution for field day villages puts much more mass on adoption rates greater than 50%. Thirty-eight percent of field day villages had adoption rates of 50% or higher, while only 19% of the control villages had at least half of the farmers adopt.

Figure 3 shows that the effect of field days is strongly correlated with attendance. The adoption of farmers in treatment villages who did not attend the field days is almost the same as those in the control villages. In contrast, the adoption rate is about 50% higher for attendees in treatment villages. Attendance is certainly nonrandom and likely correlated with household unobservables. Nonetheless, the result presents

[20]The most common explanation for not transplanting the seeds was that flooding caused damage during the nursery stage, before seedlings had been transplanted in the main field. Swarna-Sub1 is not tolerant to submergence at this stage.

[21]Five kilograms of seed is enough to cultivate about 10% to 20% of the average farmer's landholdings. Therefore, sowing this amount is not full adoption and still involves some experimentation.

[22]Including several household control variables does not change the main results (columns 4 through 6). The point estimates remain nearly identical to those that rely only on the experimental variation. This is not surprising given that the randomization was successful at achieving balance among the experimental groups.

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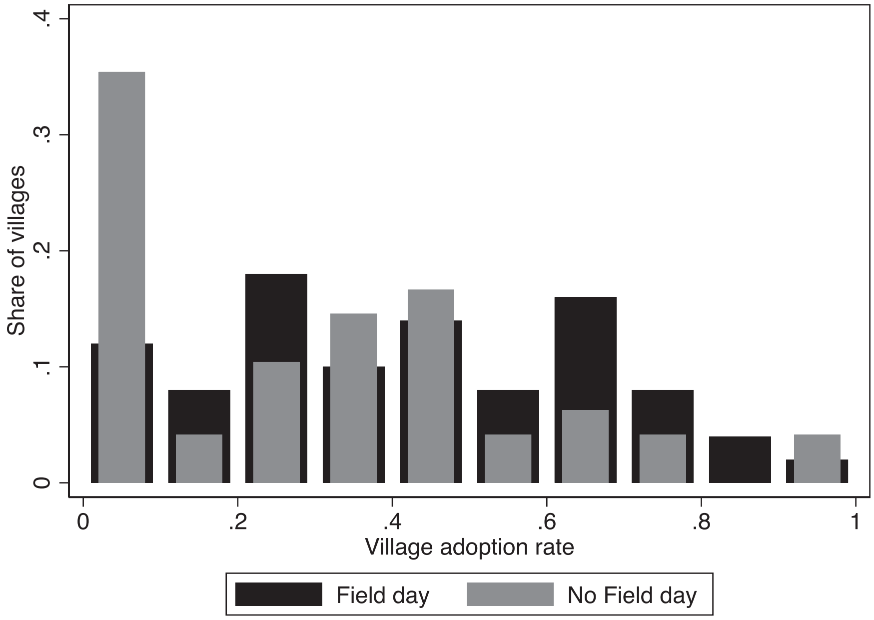
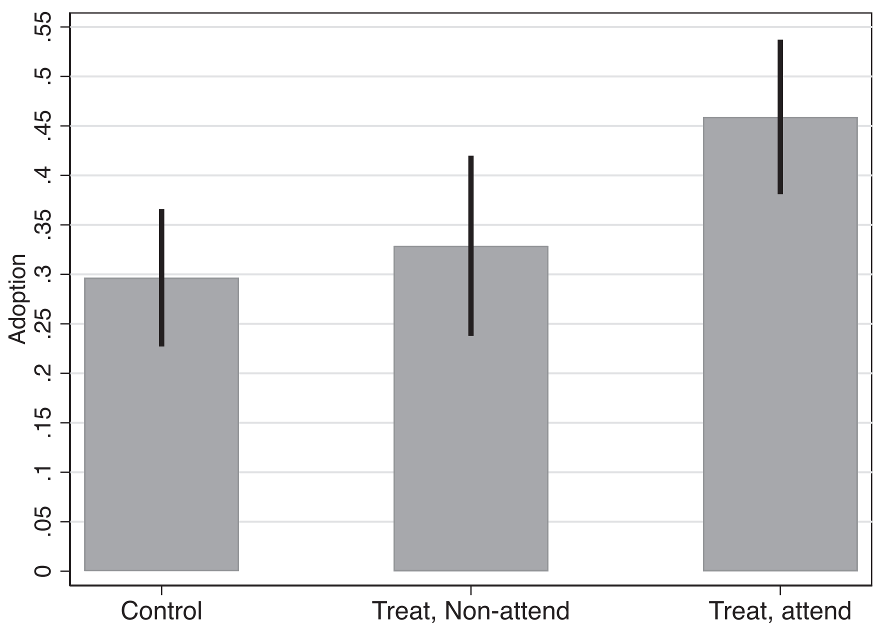
FIGURE 2.—DISTRIBUTION OF VILLAGE-LEVEL ADOPTION RATES BY TREATMENT



The figure shows the distribution of the village-level adoption rate for field day and non–field day villages separately. The distributions are based on the adoption data for the approximately fifteen farmers per village who received door-to-door sales.

FIGURE 3.—ADOPTION RATES SEPARATELY FOR FIELD DAY ATTENDEES AND NONATTENDEES



The figure shows the raw adoption rates for farmers in control villages, farmers in treatment (field day) villages who did not attend the field days, and farmers in treatment villages who attended the field days. The black heavy lines are 95% confidence intervals, where standard errors are clustered at the village level.

suggestive evidence that whatever learning happened at the field days likely did not spill over to nonattendees.[23]

C. *Does the Effect of Field Days Vary by Method of Selecting Demonstrators?*

The field days were no more effective when demonstrators were identified with meetings. Table 3 shows the full specification where the field day indicator is interacted with

[23]Table A7 further considers this by showing the same heterogeneity but with knowledge outcomes. In line with the evidence on adoption, the field days improved knowledge for attending farmers. Attending the field days is also associated with an increase in the number of conversations farmers report having about Swarna-Sub1. Most of these conversations are not with demonstrators but with people not growing Swarna-Sub1 (table A8). These results suggest that field days create a way to share information that farmers otherwise would not have shared. This information can come from people who are not current users of the technology, especially since they are larger in number. Banerjee et al. (2013) show that people without loans account for a meaningful share of the information diffusion about microfinance in

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TABLE 3.—INTERACTION EFFECTS BETWEEN FARMER FIELD DAYS AND MEETINGS

	(1) Buy	(2) Buy 5 KG	(3) Buy 10 KG	(4) Buy	(5) Buy 5 KG	(6) Buy 10 KG
Field day	0.184**	0.139**	0.045	0.188***	0.142**	0.046
	(0.070)	(0.058)	(0.044)	(0.067)	(0.055)	(0.043)
Field day × SHG meeting	−0.125	−0.148	0.023	−0.137	−0.154	0.018
	(0.108)	(0.100)	(0.071)	(0.102)	(0.096)	(0.070)
Field day × Village meeting	−0.066	−0.020	−0.047	−0.073	−0.032	−0.041
	(0.113)	(0.098)	(0.075)	(0.110)	(0.094)	(0.075)
SHG meeting	0.073	0.082	−0.009	0.080	0.093	−0.013
	(0.082)	(0.073)	(0.042)	(0.079)	(0.071)	(0.043)
Village meeting	0.015	0.017	−0.002	0.021	0.028	−0.007
	(0.078)	(0.055)	(0.058)	(0.075)	(0.053)	(0.057)
HH Controls	No	No	No	Yes	Yes	Yes
Strata FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean in nonfield day villages	0.297	0.147	0.150	0.297	0.147	0.150
Mean in ward villages	0.357	0.185	0.172	0.357	0.185	0.172
Number of observations	1,384	1,384	1,384	1,383	1,383	1,383
R^2	0.046	0.035	0.015	0.066	0.050	0.031

The dependent variable in columns 1 and 4 is an indicator for whether the farmer purchased Swarna-Sub1 when given a sales offer. The dependent variable in columns 2 and 5 is an indicator for purchase of one seed package (5 kg). The dependent variable in columns 3 and 6 is an indicator for purchase of at least two seed packages (10 kg). Household controls are indicator for ST or SC, indicator for BPL card, indicator for NREGS job card, cultivated area, indicator for thatched roof, indicator for mud walls, education of the farmer, age of the farmer, indicator for SHG membership, indicator for private tubewell ownership, indicator for cultivating Swarna, and elevation of the household. Standard errors that are clustered at the village level are in parentheses. Asterisks indicate that coefficient is statistically significant at the ***1%, **5%, and *10% levels.

the indicators for village and SHG meetings. The second row shows that if anything, the field days were less effective when demonstrators were selected by SHG meetings. The coefficient on the interaction term between field days and SHG meetings is negative, somewhat large, but statistically insignificant. Similarly, the coefficient on the interaction between field days and village meetings is also negative and imprecisely estimated. The effect of field days with ward-member selection is 18.4 percentage points. The upper bound of the 95% confidence interval for the interaction term between field days and the SHG meeting indicator is 0.088. In other words, we can rule out that SHG meetings increased the field day effect by any more than 48%. The comparable number for village meetings is 15.8 percentage points, or an 86% increase in the effect size.[24]

Our findings suggest that farmers gain no more from field days when demonstrators are chosen by the village rather than by an elected official. Farmers appear to gain just as much, if not more, from participating in field days when demonstrators are identified by ward members.

Finally, we show that results change little when measuring adoption from all sources that we obtained from our census of all rice farmers. Column 1 in table 4 shows that the coefficients for both village and SHG meetings remain small and statistically insignificant. However, we continue to estimate large, positive effects of field days on seed demand at the village level. Field days caused an increase in adoption of 6.2 percentage points, or around 60%.[25] Column 2 shows that we still fail to detect significant interaction effects between meetings and field days in this larger sample. We also test whether field days cause substitution toward Swarna-Sub1 and away from other types of seeds. Column 3 shows that the point estimate on the number of varieties grown is similar in magnitude to the effect of field days on adopting Swarna-Sub1. Also, we find no evidence that the field days led to a decrease in the number of other types of varieties being grown (column 4).

TABLE 4.—EFFECTS ESTIMATED FOR THE ENTIRE VILLAGE

	(1) Adoption	(2) Adoption	(3) Number Varieties	(4) Number Non-SS1 varieties
Village meeting	−0.008	−0.003	0.034	0.044
	(0.028)	(0.031)	(0.109)	(0.113)
SHG meeting	0.016	0.040	0.190*	0.174*
	(0.025)	(0.029)	(0.096)	(0.101)
Field day	0.062***	0.079**	0.095	0.033
	(0.022)	(0.033)	(0.085)	(0.088)
Field day × SHG meeting		−0.044		
		(0.046)		
Field day × Village meeting		−0.007		
		(0.056)		
Strata FE	Yes	Yes	Yes	Yes
Mean in non-field day villages	0.103	0.103	2.238	2.135
Mean in ward villages	0.147	0.147	2.254	2.108
Number of observations	6,511	6,511	6,500	6,500
R^2	0.054	0.055	0.123	0.074

The dependent variable in columns 1 and 2 is an indicator for whether the farmer adopted Swarna-Sub1 for the 2015 season. The dependent variable in column 3 is the total number of rice varieties grown, while the dependent variable in column 4 is the number of non-Swarna-Sub1 varieties grown. The data are from a census of varietal adoption carried out with all households in each village shortly after planting decisions were made for the 2015 season. Standard errors that are clustered at the village level are in parentheses. Asterisks indicate that coefficient is statistically significant at the ***1%, **5%, and *10% levels.

Indian villages. Part of the reason for this is that there are more people without loans.

[24]We gain more power by pooling the two types of meetings together (table A9). When doing this, we are able to reject that the average effect of meetings on the effectiveness of field days is any larger by around 8.9 percentage points (48%).

[25]The much lower adoption rate at the village level is indicative of supply constraints. Thirty-six percent of our sample who received door-to-door sales adopted, a number much larger than the adoption rate among other villagers. The 10% adoption rate in the control group, combined with little awareness at baseline, suggests that Swarna-Sub1 is gaining popularity. This might be driven by efforts to promote the variety by the state government.

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TABLE 5.—DIFFERENTIAL EFFECTS OF FIELD DAYS AS FUNCTIONS OF CASTE AND POVERTY STATUS

	(1) Buy	(2) Buy 5 KG	(3) Buy 10 KG	(4) Buy	(5) Buy 5 KG	(6) Buy 10 KG
Field day	0.082	0.046	0.036	0.071	0.022	0.049
	(0.050)	(0.048)	(0.038)	(0.061)	(0.056)	(0.039)
Field day × ST or SC	0.119	0.112*	0.007			
	(0.079)	(0.066)	(0.055)			
Field day × BPL card				0.080	0.098*	−0.019
				(0.060)	(0.056)	(0.043)
SHG meeting	0.008	0.011	−0.003	0.008	0.011	−0.003
	(0.053)	(0.050)	(0.038)	(0.053)	(0.050)	(0.038)
Village meeting	−0.017	0.012	−0.029	−0.014	0.015	−0.029
	(0.056)	(0.049)	(0.038)	(0.056)	(0.048)	(0.038)
HH Controls	Yes	Yes	Yes	Yes	Yes	Yes
Strata FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean in nonfield day villages	0.297	0.147	0.150	0.297	0.147	0.150
Mean in ward villages	0.357	0.185	0.172	0.357	0.185	0.172
Number of observations	1,383	1,383	1,383	1,383	1,383	1,383
R^2	0.066	0.047	0.030	0.065	0.047	0.030

The dependent variable in columns 1 and 4 is an indicator for whether the farmer purchased Swarna-Sub1 when given a sales offer. The dependent variable in columns 2 and 5 is an indicator for purchase of one seed package (5 kg). The dependent variable in columns 3 and 6 is an indicator for purchase of at least two seed packages (10 kg). Household controls are indicator for ST or SC, indicator for BPL card, indicator for NREGS job card, cultivated area, indicator for thatched roof, indicator for mud walls, education of the farmer, age of the farmer, indicator for SHG membership, indicator for private tubewell ownership, indicator for cultivating Swarna, and elevation of the household. Standard errors that are clustered at the village level are in parentheses. Asterisks indicate that coefficient is statistically significant at the ***1%, **5%, and *10% levels.

D. *Who Benefits the Most from Field Days?*

Turning to heterogeneity, the field days were most effective for poorer farmers, as measured by caste and BPL status. First, around a third of the sample belongs to the scheduled castes or tribes, the most disadvantaged castes in the country. Members of scheduled castes and tribes obtain less education and earn lower incomes relative to higher-caste individuals (Munshi & Rosenzweig, 2003). Column 1 in table 5 shows that the marginal impact of field days on adoption for higher-caste farmers is 8.2 percentage points. This impact increases to 20.1 percentage points for farmers belonging to the scheduled castes and tribes; however, the large differential effect is not statistically significant ($p = 0.14$). Column 2 shows that this differential effect is largely driven by inducing lower-caste farmers to purchase a single package of seeds. The effect of field days on adoption of a single package is only 4.6 percentage points for higher-caste farmers. In contrast, the effect is over three times larger for scheduled castes and tribes, and the differential effect is statistically significant at the 10% level. Column 3 shows that there is virtually no differential effect for scheduled castes and tribes on the probability of purchasing two packages.

Second, we explore heterogeneity by having a BPL card. About 62% of our sample holds one of these cards, which are allocated based on results from a proxy means test. Column 5 shows that field days are more effective at inducing BPL households to purchase a single package of seeds.

Taken together, the results suggest that field days increase equity by delivering the largest impacts for the poorest farmers. These gains exist despite a lack of evidence that poor farmers learn better from field days. Tables A10 and A11 show that the effect of field days on observed learning is not significantly larger for either ST/SC or BPL households. Therefore, the differential effects on adoption must arise for a reason other than differential learning, at least for the attributes measured by our survey.

TABLE 6.—PARAMETERS OF THE COST-EFFECTIVENESS CALCULATION

	(1) Value
Benefits	
1. Effect on Swarna-Sub1 adoption rate (table 2)	0.122
2. Number of rice-farming households per village	69
3. Number of expected adopters from field day (item 1 × item 2)	8.42
4. Increased revenue from Swarna-Sub1 adoption (Emerick et al., 2016)	$49.4
5. Cost of additional inputs (Emerick et al., 2016)	$18.35
6. Net benefit per adopter (item 4 − item 5)	$31.05
7. Total one-year benefit from field day per village (item 3 × item 6)	$261.44
Costs	
8. Cost of administering field day by NGO, per village	$200
9. Average number of farmers attending	41
10. Time cost per attendee based on casual rural wage (2 hours)	$0.73
11. Total cost of farmer time (item 9 × item 10)	$29.9
12. Total cost of field day per village (item 8 + item 11)	$229.9
One-year net benefit per village (item 7–item 12)	$31.54
One-year benefit-cost ratio (item 7/item 12)	1.14

E. *Are Field Days Cost-Effective?*

The field days are cost-effective, delivering a benefit-cost ratio of around 1.14 after a single growing season (see table 6). To see this, we first measure the additional profit they create. The average village in our sample has 69 rice farming households, and field days increased the adoption rate by 12.2 percentage points. Thus, a field day would be expected to generate around 8.42 additional adopters. In Emerick et al. (2016), we estimate revenue gains from Swarna-Sub1 of 10%, or about $49.40 (all dollars are U.S. dollars).

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This effect arises partly due to the crowd-in effect of inducing farmers to use more inputs. Taken together, the profit gain from adoption is approximately \$31.00, meaning that field days generate one-year revenue gains of around \$261.00 at the village level. Next, we measure their cost. The average cost of carrying out the field day was about \$200.00. This figure includes all costs for the field partner including labor, transportation to the village, and inviting farmers to the field days. A rough estimate of the time cost to farmers of attending the field days is \$29.90.[26]

On the one hand, this calculation is encouraging because many farmers reuse seeds and continue to benefit from Swarna-Sub1 over multiple seasons. The one-year benefit therefore gives a lower bound on the flow of benefits received from continued adoption. On the other hand, the calculation should be interpreted with caution for two reasons. First, it is unclear whether the average cost of the treatment would rise (or possibly fall) with wider implementation. There could be additional costs of coordinating field days in a broader area. Second, our estimated treatment effect is conditional on the absence of supply frictions. We can only think of field days as being cost-effective when seeds are readily available to farmers at market prices.[27]

F. *What Explains Why Field Days Are Effective?*

Numerous reasons exist for why the field days increase adoption. We list four possible explanations. First, the field days could simply increase awareness about the existence of Swarna-Sub1. Second, they could allow farmers to gain information from multiple demonstrators, allowing for better information aggregation. Third, they could have made the difficulty of finding Swarna-Sub1 seeds more salient. Doing so may convince farmers to purchase when visited by a salesperson. Fourth, field days may have complemented regular social learning, either by inducing farmers to communicate in ways they otherwise would not have or because the NGO could have provided additional information that did not transmit through networks. While the experiment does not allow us to distinguish between these explanations, we can explore the data to understand which mechanisms might be in operation.

The awareness mechanism seems unlikely. While the field days increased awareness (see tables 1 and A7), the effect size is small and most farmers knew about Swarna-Sub1 independent of the field days. Moreover, the field days also increased adoption for demonstrators.[28] Table 7 shows that demonstrators were 11.8 percentage points more likely to adopt Swarna-Sub1 in 2015 if they resided in a field day village. Demonstrators did not need field days to gain awareness, further suggesting this is not the mechanism.

Table 7.—Effects of Field Days on Adoption of Demonstrators during the 2015 Season

	(1)	(2)
Field day	0.118**	0.118**
	(0.054)	(0.052)
SHG meeting		−0.033
		(0.079)
Village meeting		−0.101
		(0.066)
Strata FE	Yes	Yes
Mean in non–field day villages	0.178	0.178
Number of observations	397	397
R^2	0.071	0.082

The dependent variable in both columns is an indicator for whether the farmer adopted Swarna-Sub1 for the 2015 season. The data are from a census of varietal adoption that was carried out with all households in each village shortly after planting decisions were made for the 2015 season. Both regressions are estimated only on the sample of farmers matched to the list of demonstrators. Standard errors that are clustered at the village level are in parentheses. Asterisks indicate that coefficient is statistically significant at ***1%, **5%, and *10% levels.

We next show suggestive evidence that the field day effect is not driven by information sharing from demonstrators. Figure 4 shows the adoption differences between field day and control villages as a function of the number of demonstrators. There is no evidence that the field-day effect increases with the number of demonstrators. Moreover, the figure shows a weak correlation between adoption and the number of demonstrators attending the field day. Finally, the results showed no evidence that selecting demonstrators with meetings led to more effective field days, despite the fact that more demonstrators attended the field days in the meeting villages.[29]

The use of door-to-door sales raises the question of another mechanism. Perhaps the field days caused farmers to notice that Swarna-Sub1 is hard to find. This may trigger them to capitalize on a buying opportunity when a door-to-door salesperson shows up. We might expect the field days to have a different effect for a widely available technology if this is the true mechanism. The adoption survey with the whole village, not just the door-to-door sample, provides an opportunity to test this mechanism. Table A13 shows that a treatment effect still exists when we remove farmers who were part of the door-to-door sample. This evidence suggests that the effect of field days is not being driven by the method used to elicit demand.

Finally, we find no evidence that field days are more effective in areas exposed to flooding. We calculate the distance beweeen demonstrator plots and flooded areas using daily images from the Modis satellite.[30] Table A14 shows

[26]This calculation is based on daily wages of 174 rupees (\$2.90), the wage in the central government's labor guarantee program. We multiply this by 0.25 since the field days took approximately two hours. Finally, an average of 41 farmers attended the field days.

[27]Using the treatment effect on overall adoption in table 4, we calculate a benefit-cost ratio of 0.58. In other words, the field days would take about 1.7 years to pay for themselves.

[28]We were able to match 397 of the demonstrators by name to the 2015 adoption survey. The matching rate is uncorrelated with the field days treatment.

[29]Table A12 shows that 2.7 additional demonstrators attended the field days in meeting villages, relative to 3.31 demonstrator attendees in ward member villages.

[30]The images have a 250 m resolution and are available at http://floodobservatory.colorado.edu/. We define a plot to be flooded if it was within 250 or 500 meters of a flooded pixel on any of the days between June 1 and October 31, 2014 (the five months preceding the field days).

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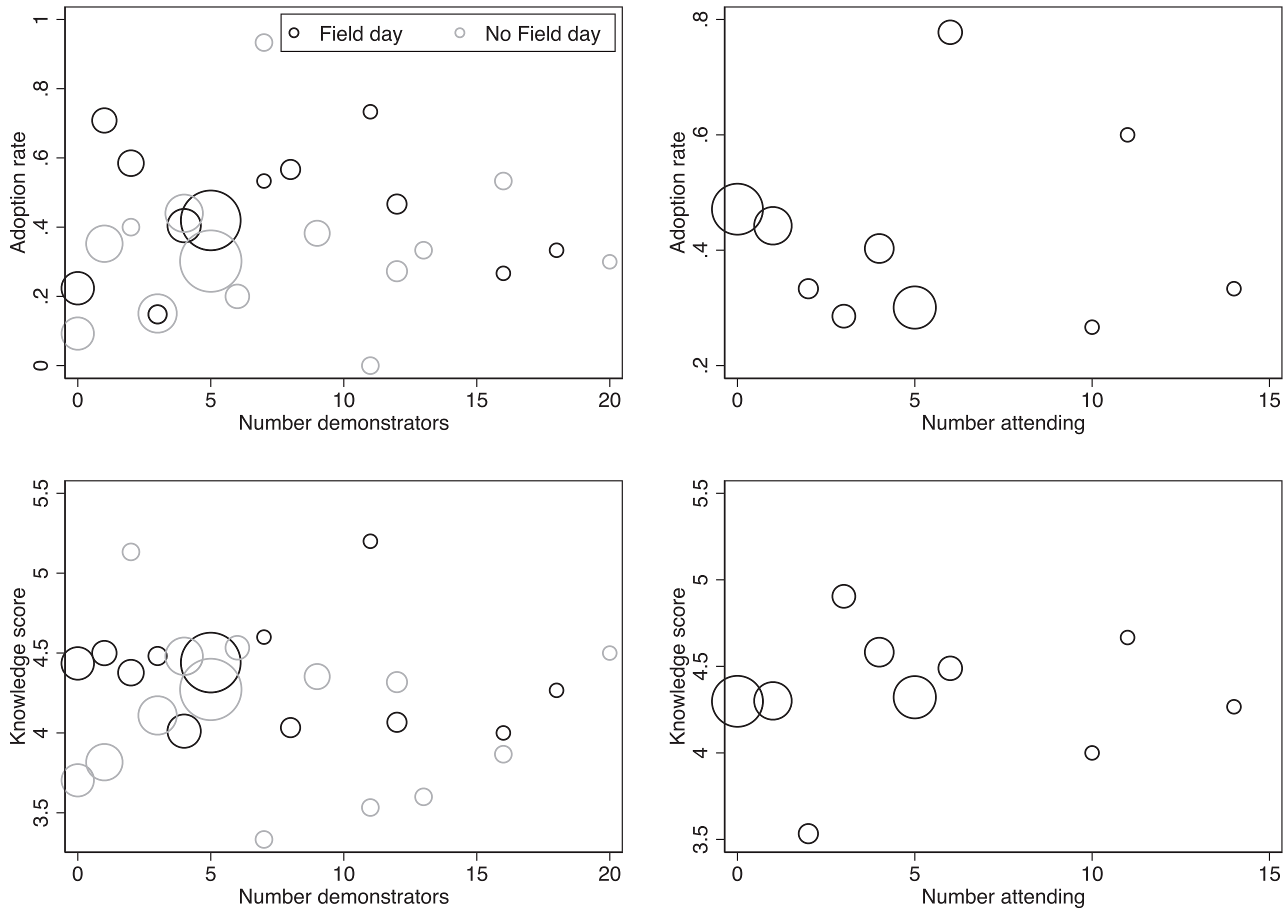
Figure 4.—Correlations between Adoption, Knowledge, Number of Demonstrators, and Number Attending the Field Day



The upper left panel shows the correlation between adoption and the number of demonstrators in the village who transplanted Swarna-Sub1, separately for field day (black) and control (gray) villages. The size of each bubble is proportional to the number of villages for each combination of treatment and number of demonstrator combination. The lower left panel depicts the same thing except for the knowledge score instead of adoption. The upper right figure shows the correlation between adoption and the number of demonstrators who attended the field day, where the size of each bubble is again proportional to the number of observations. The lower right figure shows the correlation between knowledge and the number of adopting demonstrators. Knowledge is defined as the total number of correct responses, as in table 1 column 9.

heterogenous effects based on proximity between the demonstrator plots and flooding. We find no evidence that field days work better when flooding causes the main benefit of Swarna-Sub1 to become more apparent. This finding helps rule out a mechanism where the field days give farmers an opportunity to verify benefits of a new technology.

Combining all results, we find that going to field days enhances learning and increases adoption. This does not seem to be driven by learning more from demonstrators or by validating the main benefit of the technology. The results instead suggest that farmers need more information than the amount transmitted from demonstrators. The field days most likely work because they provide that information or endorsement.

V. Conclusion

Farmers need to be convinced about a new technology before adopting it. We have shown that the farmer field day, where farmers come together to learn about and discuss a new technology, improves learning and achieves increased adoption in a cost effective manner. The magnitude of this effect is nontrivial: field days in our experiment increased adoption rates by 40%. This result suggests that learning is a key friction that slows the diffusion of agricultural technology and that field days serve as an effective mechanism for alleviating this friction. While we are not able to exactly pinpoint the mechanism behind this effect, we found suggestive evidence that participants may have benefited from learning from other people who were not using the technology—either other participants or the NGO running the field day.

We also tested whether the ex-ante selection of demonstrators can be improved by seeking the input of farmers through village meetings. We found that these meetings do change the composition of the group of demonstrators. More specifically, using meetings shifts the pool of demonstrators away from friends and family of locally elected political figures. However, this has no meaningful effect on technology adoption one season later. This result in no way means that careful selection of demonstrators is unimportant. Instead, our results suggest that using meetings to engage villagers in this selection process does little to drive adoption. Thus, future work is needed to identify the most policy-relevant and scalable methods to improve the selection of demonstrators.

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The experiment delivers a straightforward policy lesson. Models of agricultural extension that rely on contact or lead farmers, and the spread of information from these farmers to other farmers can result in underadoption of profitable technology. Consequently, there is room to increase adoption by intervening to encourage farmers to better learn from each other's experience. Rather than exploiting social learning alone, improved extension models could combine social learning from selected contact farmers with simple interventions to improve learning.

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