Optimizing social learning about agricultural technology: Experiments in India and Bangladesh

Kyle Emerick, Alain de Janvry, Elisabeth Sadoulet, Erin Kelley, and Manzoor Dar

Tufts University, University of California Berkeley,
and International Rice Research Institute

FERDI
June 2, 2016

Research motivated by interest in improving agricultural extension

- Limitations of current system:
  - Limited resources: 90K extension workers only reach 7% of farmers
  - T&V and demonstrations require farmer-to-farmer info sharing
- Other ideas based on how farmers learn
  1. ICT
  2. Selection of demonstrators
  3. Demonstrations with counterfactuals
  4. Ability of field days to facilitate learning
  5. Should farmers even be the final recipients of extension services?

Field experiments to study three specific questions in India and Bangladesh

1. Bangladesh:
   - How can demonstrators of new technology be selected to increase spread of information? Is farm size good proxy?
   - Do farmers pay attention to outcomes from all demonstrators, or does heterogeneity make some signals uninformative? Does this create tension between quality for spreading information and quality as demonstrator?
   - Can counterfactual plots for demonstration improve learning, particularly when large differences between demonstrators and farmers? ▸ example demo plot

Field experiments to study threespecific questions in India and Bangladesh

2. India:
   - Can farmer field days, i.e. simple venues where demonstrators share information about new technology, facilitate learning and increase adoption?
3. India:
   - Should seed dealers be the recipient of extension services?
   - In absence of formal extension, seed dealers oft-cited source of info.
   - **Idea:** Farmers not incentivized to spread info.
     - Dealers capture gains from increasing demand, i.e. marketing
     - Much easier to “treat” dealers with extension
   - **Possible bad outcome:** Worse targeting

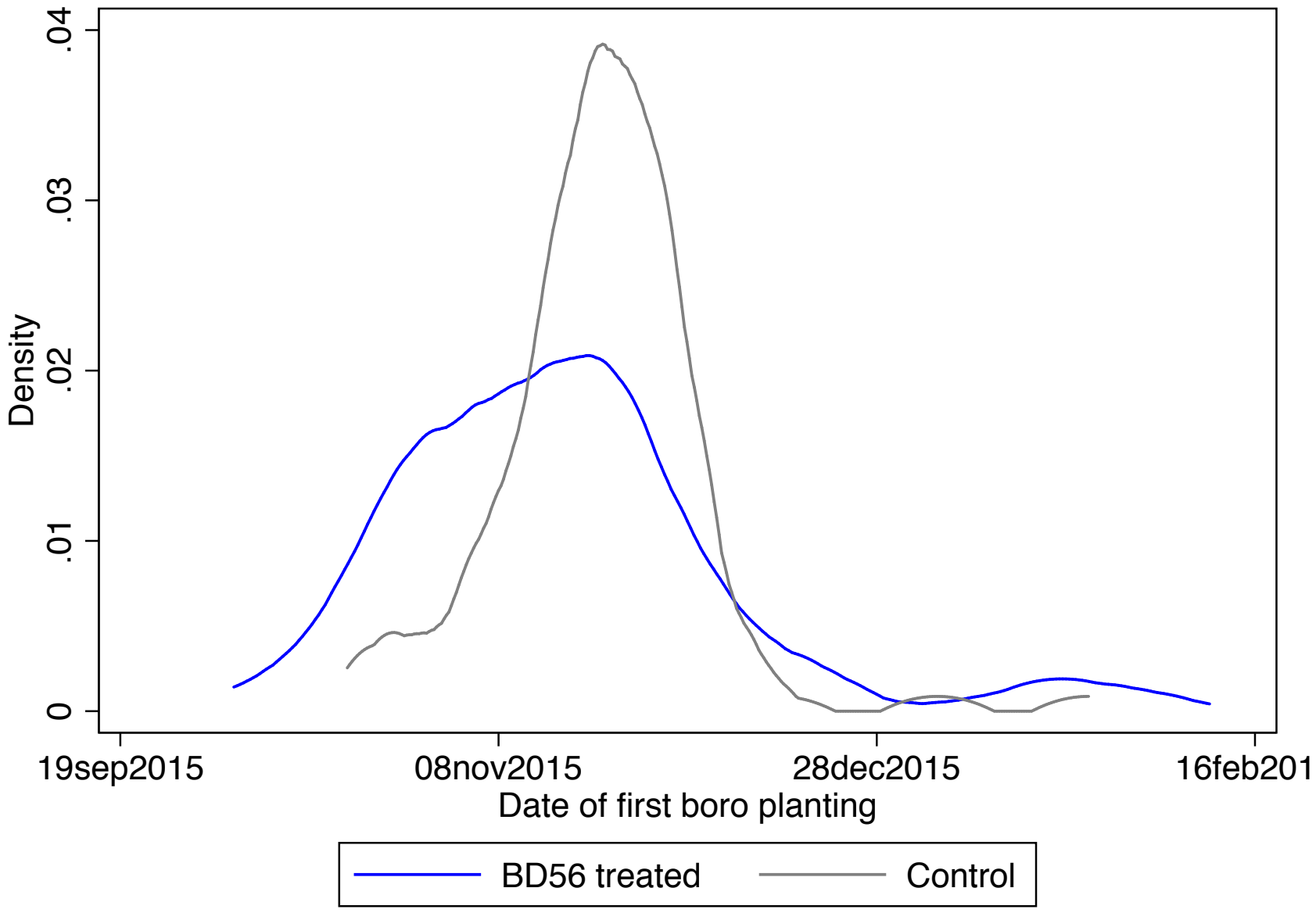
Starting with Bangladesh, we piloted with some ideas last season

- 35 villages in Rajshahi division of Bangladesh ▸ location
- Introduced BD56, new rice variety for wet season that:
  1. Requires less water
  2. Matures earlier
  3. Yields less
- 5 demonstrators received 5 kg seed in each of 30 villages
- Demonstrators selected either randomly, largest farmers, self-reported WTP, voted by peers, closest to village mean observables
- All did counterfactual plot
- No seeds given, but hypothetical recipients surveyed in control villages

Purposes of the pilot

1. Proof of concept
2. Verify 3 attributes of BD56
3. Speculate about entry points

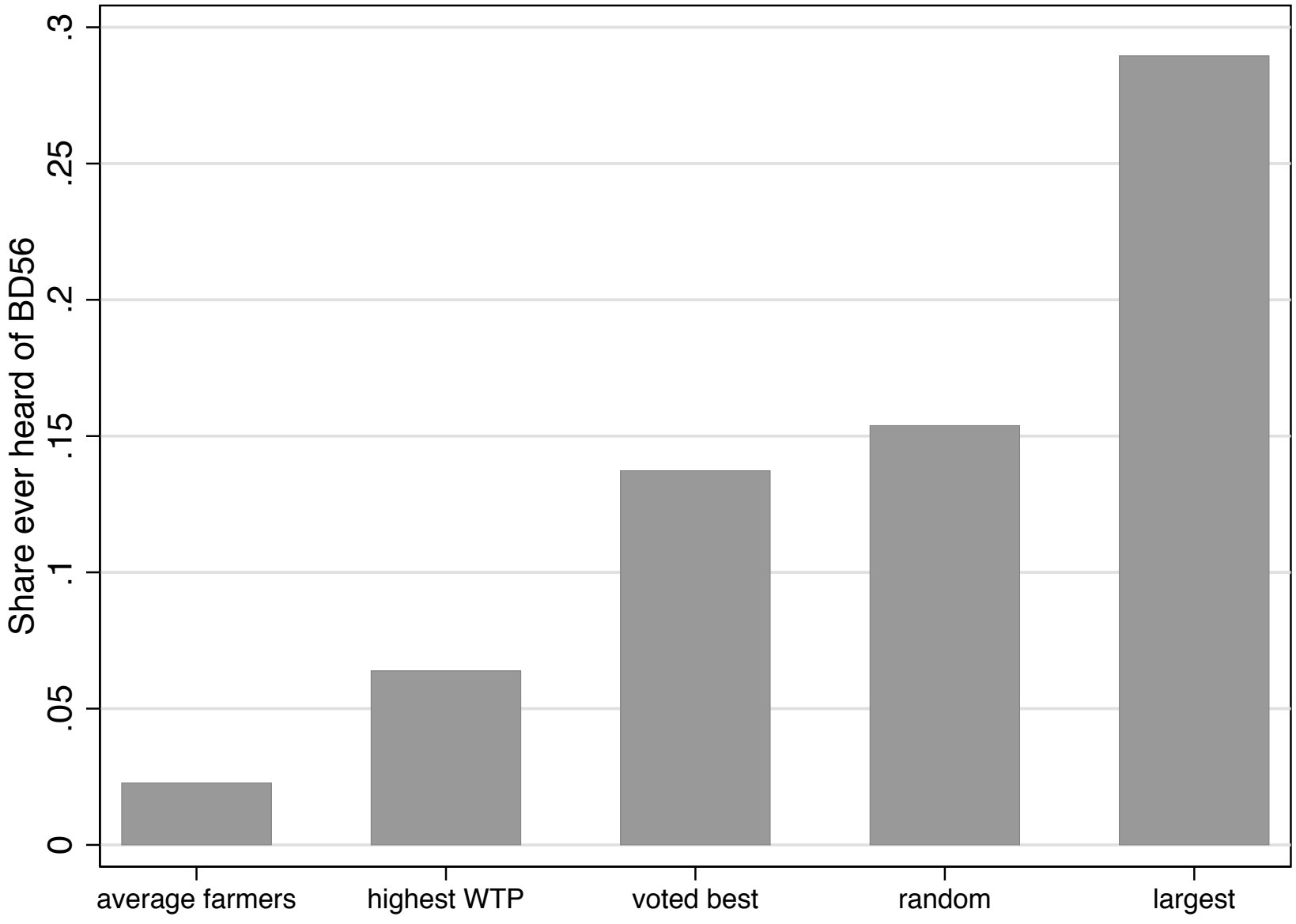
BD56 shifts up dry season planting by maturing earlier



BD56 yields less, but requires fewer irrigations

	(1) Yield	(2) Duration	(3) Irrigations	(4) Boro planting
BD56 treatment	-227.032	-9.013	-8.192*	-4.865*
farmer	(178.285)	(5.718)	(4.589)	(2.777)
Constant	1923.449***	96.381***	12.554***	20.513***
	(156.854)	(4.103)	(4.511)	(1.453)
Mean of Dep Variable	1800.02	91.42	8.05	17.82
Number of Observations	252	260	260	257
R squared	0.022	0.019	0.130	0.016

Large farmers are best for spreading information



The main experiment was rolled out in March

- 256 villages - 11 upazilas in Rajshahi, size capped at 150 HH
- Door-to-door census of villagers including info. network ✓
- 192 villages: 5 demonstrators, 5 kg BD56 distributing now
  - Selected randomly, by agricultural officer (SAO), or largest rice farmers
- 64 control villages: approx. 15 demonstrators, 5 kg BD51 (Swarna-Sub1) distributing now
  - Same selection mechanisms applied
  - Control villages only for assessing impact

Counterfactual plots will be crossed into 192 BD56 villages

- 96 villages: Farmers carry out business as usual cultivation without counterfactual. One stick given to mark demo.
- 96 villages: Farmers set aside some land for “head-to-head” comparison. Two sticks given to mark demo.

- Counterfactual plot eliminates fixed characteristics (i.e. ability)
- Allows farmer to assess gains and avoid extrapolating demonstrator’s outcome to her own situation

Sequence of events in the experiment

After harvest, but before planting:

- Ask whether ever heard of BD56 and who talked to
- Ask knowledge of outcomes from demonstrators
- After measuring, provide this info directly to farmers:
  - Outcomes from BD56 plot in 96 villages
  - Outcomes from BD56 and counterfactual plot in 96 villages

After next two plantings:

- Surveys to measure adoption

The model we have in mind ....

1. Five demonstrators selected
2. Each demonstrator cultivates and outcome realized. Outcome is $f_{nj}(z_j)$ where n stands for "new" technology, j indexes demonstrators, and z_j is some observable attribute of demonstrator j
3. The demonstrators pass information to each of their social contacts independently with a probability of p. If information is passed, then it includes telling about the variety and the outcome $f_{nj}(z_j)$.

The model we have in mind ....

4. If informed, the farmer *i* pays attention to demonstrator j's outcome with some probability $\gamma = h(|z_j - z_i|)$.
5. The farmer adopts if informed and the average outcomes of the demonstrators that he pays attention to is greater than his next-best outcome, denoted by $f_{oi}(z_i)$.

The model we have in mind ....

4. If informed, the farmer *i* pays attention to demonstrator j's outcome with some probability $\gamma = h(|z_j - z_i|)$.
5. The farmer adopts if informed and the average outcomes of the demonstrators that he pays attention to is greater than his next-best outcome, denoted by $f_{oi}(z_i)$.

Identification (when demonstrators selected randomly):

- Variation in knowledge identifies *p*
- Variation in adoption tells us about *h*

Counterfactual plots:

- Should increase adoption the most for farmers furthest from demonstrators

We already have network data. Thus, can simulate info diffusion across treatments

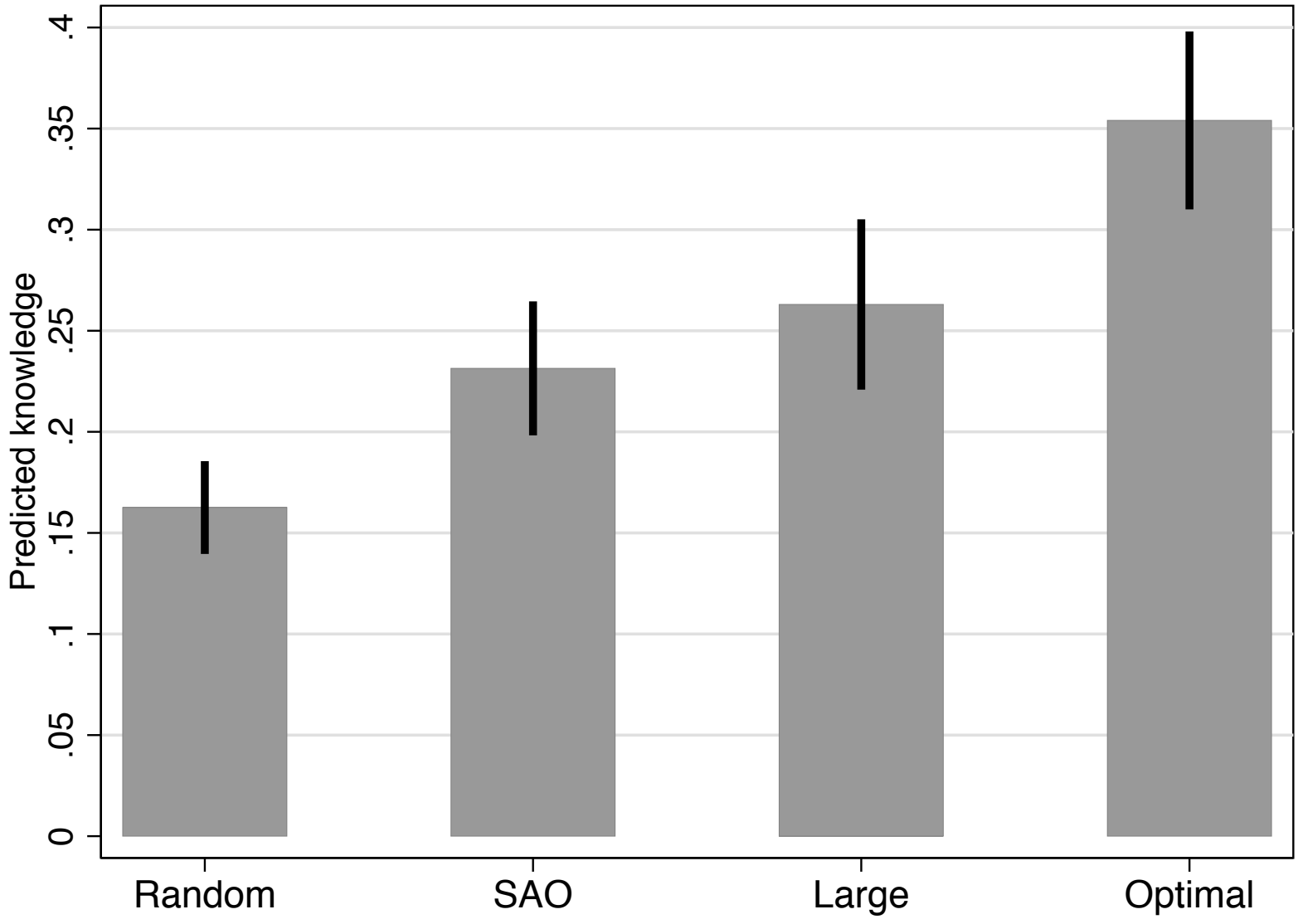
1. Demonstrators chosen using one of three methods (random, SAO, or largest rice area)
2. Demonstrators pass information to each of their social contacts with p=0.5
3. Farmer informed if receives info from demonstrator
4. Demonstrators informed with probability 1

We already have network data. Thus, can simulate info diffusion across treatments

1. Demonstrators chosen using one of three methods (random, SAO, or largest rice area)
2. Demonstrators pass information to each of their social contacts with p=0.5
3. Farmer informed if receives info from demonstrator
4. Demonstrators informed with probability 1

$\rightarrow$ **Predicted variation across selection methods all due to underlying network structure**

Network position explains why large farmers better for spreading info.



Large and SAO-selected farmers different along several dimensions

		Coefficients and SE:		
	(1) Constant	(2) SAO	(3) Large farmers	(4) p-value (2)-(3)
Rice area	7.253***	5.592***	18.902***	0.000
	(0.615)	(1.271)	(2.429)	
Total area	8.985***	5.894***	22.383***	0.000
	(0.675)	(1.377)	(2.817)	
Education	4.587***	1.306***	1.210**	0.853
	(0.310)	(0.468)	(0.496)	
Age	42.297***	0.637	3.710***	0.004
	(0.756)	(1.038)	(1.096)	
Times named best farmer	0.774***	4.480***	5.969***	0.149
	(0.209)	(0.785)	(0.726)	
Female respondent	0.135***	0.006	-0.029	0.377
	(0.027)	(0.039)	(0.038)	

Large and SAO-selected farmers different along several dimensions

		Coefficients and SE:		
	(1) Constant	(2) SAO	(3) Large farmers	(4) p-value (2)-(3)
Log yield	2.831***	0.059*	0.071*	0.741
	(0.028)	(0.035)	(0.042)	
Tubewell owner	0.097***	0.094***	0.197***	0.069
	(0.023)	(0.037)	(0.053)	
Log Urea per bigah	2.992***	0.005	-0.016	0.616
	(0.031)	(0.043)	(0.044)	
Log DAP per bigah	2.719***	-0.029	-0.034	0.907
	(0.030)	(0.043)	(0.039)	
Wheat in boro	0.245***	0.028	0.188***	0.021
	(0.044)	(0.060)	(0.070)	
Vegetable in boro	0.235***	0.015	0.085	0.236
	(0.040)	(0.055)	(0.059)	

Further results

Check back in 24 months

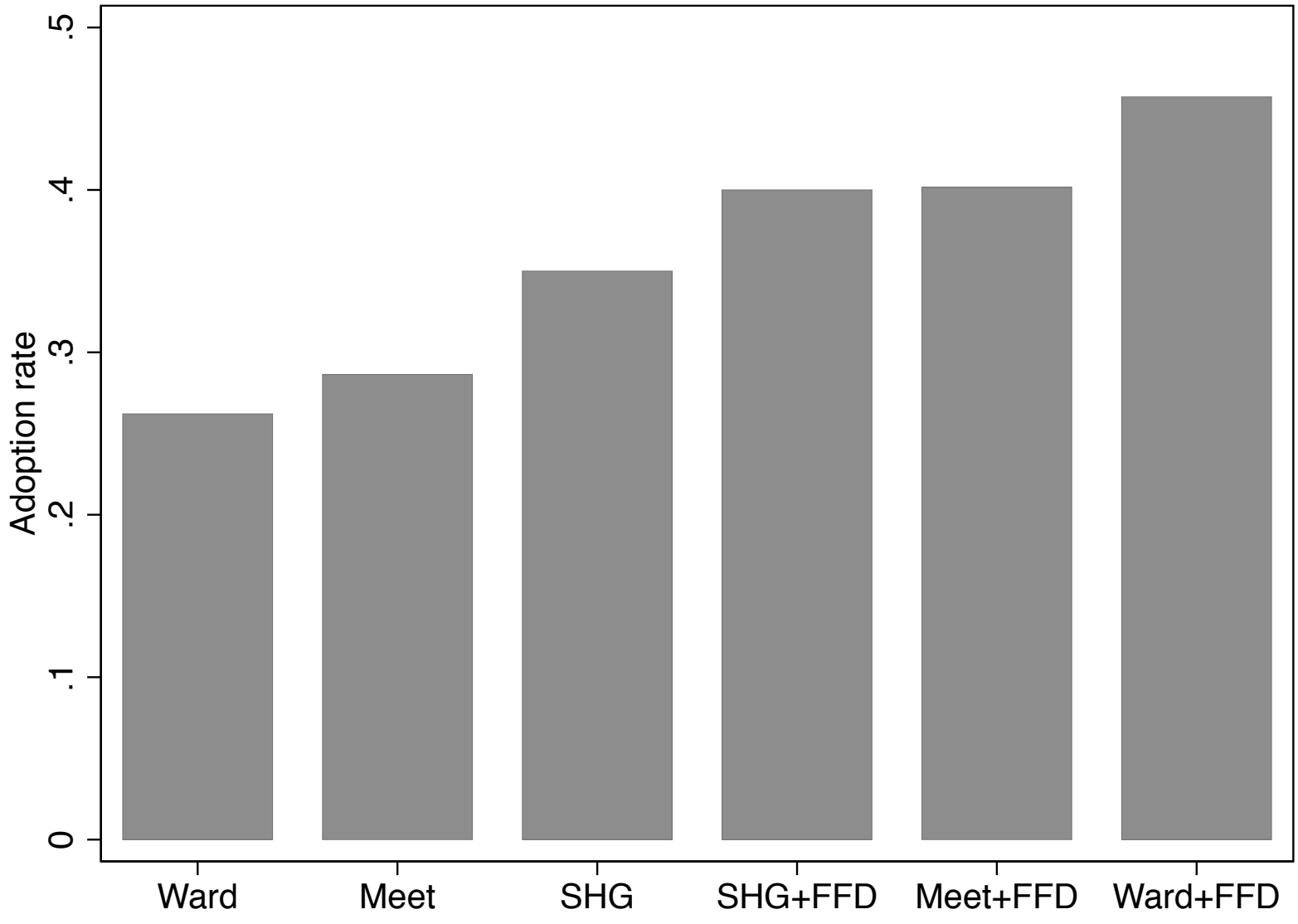
Farmer field days and learning in India

- If spreading information is costly, demonstrators may not do it automatically
- Incentives can help (BenYishay and Mobarak)
- Another possibility is that traditional farmer field day can facilitate communication and learning
- Field day is simple “village meeting” where NGO introduces the technology, demonstrators talk about their experience, and then visit field
- Common in India as part of National Food Security Mission

The experiment:

- 5 demonstrators of new flood-tolerant rice selected in 100 villages: either by village meeting, SHG meeting, or local politician (ward member)
- Demonstrators cultivate
- Field days in 50 random villages before harvest
- Seeds offered in door-to-door sale for random 15 farmers per village (eliminate supply barriers from experiment). Near market price
- Experiment identifies impact of field days and whether this varies when demonstrators are less connected to politician

The punchline is that field days increase adoption, if anything most with ward-member selection



The third experiment, also in India

Question: Should seed dealers be the recipient of extension services?

Experiment:

- 72 blocks in coastal belt of Odisha. ▸ location
- 36 blocks: BAU extension
  - Seed packages + info. given to 10 leading farmers in 2 villages
  - Block ag officer helped identify villages and farmers good for demo
  - Leading farmers from other villages will be invited to farmer field days
  - Simulates NFSM “cluster” demonstrations
- 36 blocks: Dealer-based extension
  - 5 dealers receive 2 packages each + info
  - Dealers test as they wish
  - If requested, dealers provided link with private company to obtain seeds

Delivering extension to dealers

Hypothesis

- If dealer convinced seed is good, then incentives aligned for them to increase demand:
  - Carry seed themselves (supply effect)
  - Marketing / spread info (demand effect)
- However, dealers don't have incentive to improve targeting
  - Relative to most popular variety, SS1 Returns ≥ 0
  - Also depends on reputation concerns
- Concerns about equity? Do dealers only serve wealthy farmers?

Timeline of future events for the study

- Delivering seed and info is ongoing
- October-November 2016: Organize farmer field days in traditional extension blocks. Partnership with extension service
- August 2017 and 2018: Survey on adoption, 2 random villages per block
- Ways to characterize targeting differences
  - Flood-risk of adopters
  - Yield of adopters
  - Other characteristics?

Results

$\emptyset$

Last thoughts / summary

- Key question of interest is how to modify extension to make it more effective
- Who is most effective at spreading info. about new technology?
- How do farmers learn — who do they pay attention to? Possibly not same as who spreads info.
- Does adding counterfactual make demonstration more effective?
- Can more of a public-private partnership in extension improve diffusion?