Learning Digitally: Evaluating the Impact of Farmer Training via Mediated Videos

Kathryn Vasilaky[*] Kentaro Toyama [†] Tushi Baul [‡] Dean Karlan [§] [¶]

April 30, 2018

Abstract

Individualized training in agriculture is costly, but necessary if newer and more sustainable methods of cultivation are to be adopted. Technology enables us to disseminate information quickly and at a low cost. Of course, whether that information will be read, used, or even misunderstood is not easily tractable, nor well documetned. We examine the effectiveness of mediated video-based training on individuals' adoption rates of a new agricultural technology (alternate wetting and drying) in rural Bihar, India. In a 3-arm clustered randomized control trial (RCT) framework, villages are randomly assigned to the treatment arm where villagers view videos developed by Digital Green (DG) with the aid of their local Self Help Groups (SHGs) mediated by a selected village representative (VRP). In addition, all participants receive standard agricultural training provided by India's National Livelihood Rural Mission (NLRM). The videos are tailored to local norms, and scalable in their dissemination. Our results indicate that adoption increases above and beyond standard training as a result of tailored and mediated videos, which feature individuals similar to themselves operating in their local setting. The probability of adoption increases by 0.05 for those who viewed DG videos, where the average adoption rate in the control group is 0.10, a 50% increase between treatment and control groups. In two sub-arms, we address farmers' uncertainty regarding the costs of adopting the new technology as well as their uncertainty regarding their personal ability to implement the technology (self-efficacy). We find that such subtler messages have a more variable and weaker effect. Messages addressing labor costs had more consistent impacts on adoption, while messages addressing self-efficacy had little to no effect.

---

[*] Columbia University, Earth Institute, and Department of Economics, Cal Poly (e-mail: `kvasilak@calpoly.edu`)

[†] University of Michigan, School of Information

[‡] University of Notre Dame, Initiative for Global Development

[§] Yale University, Jameel Poverty Action Lab South Asia

[¶] This study was pre-registered at https://www.socialscienceregistry.org/trials/313

1 Introduction

Between 2000 and 2013, middle income and high income countries saw a 48% and 57% increase in agricultural productivity, while low income countries, which produce 70% of the world's food, experienced only a 16% gain (http://wdi.worldbank.org/table/3.3). The low productivity could be due to the fact that roughly 50% of the farmers are females; yet only 5% were ever offered training (Food and Agriculture Organization, 2011). The potential global gains from training female farmers to be more productive are, undoubtedly, astounding. And yet, agricultural extension remains sparse in low income countries. There are 2,326 farmers for every extension worker in low income countries versus 395 farmers for every extension worker in high income countries (p 63, (Bahal, 2004)).

Scaling quality training is difficult. Extension trainers often have to travel long distances to reach farmers, and can only visit a few–often the most visible and prominent farmers. Increasingly, technology is being used in an effort to spread information more quickly and to a greater number of individuals (Aker, 2011; Fafchamps and Minten, 2012; Nakasone et al., 2014). The gains to rapidly scaling the delivery of knowledge and know-how are potentially highest in areas where there are large numbers of women and the extreme poor that do not have access to direct training.[1] Free online education platforms have set the stage for the educational landscape in the developed world[2], but these are not accessible to remote regions. Similar endeavors have followed suit in the emerging economies with SMS and video-based learning: Hole in the Wall, the Awethu Project, Google.org's SMS studies, and Digital Study Hall to name just a few, yet evidence based research as to the success of technology driven education is inconclusive.[3]

As Toyama (2015) shows, technology by it self cannot deliver an education. Programs that have mandated computers for schools have shown little effect (Barrera-Osorio and Linden, 2013; Cristia et al., 2012; de Melo et al., 2013), sometimes even detrimental effect– by either misuse of the computers (playing games) or by shifting focus away from the actual education. Although, some researchers have shown that that technology can be a complement to an already functioning program but not stand-in for one (Linden, 2008). In online learning, the gains are not straightforward due to self-selection –and Xu and Jaggars (2013) even found a negative impact overall, when controlling for individual characteristics. Murphy et al. (2014), in their study of Kahn Academy, found it difficult to perform a proper evaluation of its effectiveness due to continuously changing modern platforms; but nevertheless, one overarching observation from their study is that teachers tended to use the Kahn Academy's for supplementary materials–banks of problem sets than the video content itself. This agrees with the conclusion made by (Anthes, 2015) that technological support tools have no effect if users are not engaged, which comes through participation, framing, and having a common social goal (Anthes, 2015).

The same conclusion can be made in agricultural training. In agriculture, training via technology often comes in the form of mobile messaging, as rural villagers rarely have access to a computer Messaging in training is mixed. Cole and Fernando (2012) finds that farmers will follow information without a real understanding; Feder et al. (2004) shows that the gains

---

[1] We define the extreme poor as living on $1.25 per day

[2] Such as MIT open courseware, Coursera, Khan Academy, CodeSchool.

[3] Here we do not include reminder messages as a form of education preset.

in knowledge via SMS are modest, and Munshi (2004) shows that, at the end of the day, the salience of a message is driven by the social proximity of the individual delivering it, which a text message is frequently devoid of. In a study regarding health and HIV practices, researchers found that the information delivered by SMS was even misunderstood or misused (Jamison et al., 2013).

This research studies the effectiveness of video-based intervention that goes beyond just messaging, and aims to train and educate individuals via a well-established non-governmental organization, Digital Green.org. Digital Green's (DG) distinguishing feature is in its employment of technology to amplify human interaction rather than replace it. DG works via established local female self-help groups (SHGs). Its lessons are narrated by successful local farmers, and mediated by a live local village representatives (VRP). The coordination necessary to meet the demands of a curating a video, which is then led by a trained VRP, can lead to a far more nuanced process and outcome than a mobile SMS service inserted into the hands of a villager. Lessons are produced according to the local village demands for new agricultural practices, and their delivery are tailored to match the local language and norms of that village. Despite the preparation necessary to produce each video, the method is far more scalable at the consumer level than Farmer Field Schools or traditional "training & visit" extension services, which require a greater degree of expert human presence that typically reaches only the upper echelon of farmers in a village (Anderson et al., 2006). To date, Digital Green has reached over 640,000 rural community members across over 7,000 villages in 9 states in India and parts of Ethiopia and Ghana.

Technology adoption and low adoption rates are a well-studied subject with overarching evidence that there are no turnkey solutions. Dozens of studies have cited low adoption of fertilizer (Duflo et al., 2010; Harou and Barrett, 2014), new agricultural techniques (Bandiera and Rasul, 2006; Conley and Udry, 2010), savings (Karlan et al., 2012), agricultural insurance (Mobarak and Barrett), or better preventative health measures (Cohen, 2014; Cohen et al., 2012). One overarching principle is that the decision to adopt is a slow one that is influenced by several behavioral factors that fall outside of constrained utility maximization, including: peer effects (BenYishay and Mobarak, 2014; Breza, 2014; Bursztyn et al., 2014; Field et al., 2013), loss aversion, time inconsistency, discounting, and changes in cognitive function (Mani et al., 2013), risk and ambiguity around the technology itself (Barham et al., 2014; Galarza, 2009), and self efficacy (Bandura, 2000; Bandura et al., 1996), among many others. The mechanism by which behavior or choices can change will depend on the underlying model that individuals face, i.e. their resources, preferences, and constraints, as well as what aspect of the latter three we hope to affect. Part of this research is to test some of the underlying assumptions that institutions like DG may have regarding their users.

Our main hypothesis is whether information delivered via existing social constructs, and streamlined via technology (videos), has added value beyond agricultural extension. The second hypothesis is whether farmers, who have the necessary information to increase their productivity and livelihoods, face a high degree of uncertainty of the technology's costs as well as their ability to implement the technology to make adoption cost effective. Thus, in addition to testing the overall mediated video-based approach on farmer adoption levels, we also focus on two aspects that DG's implementers frequently cited as barriers to adoption, namely, the degree of uncertainty around the cost of a new practice and the uncertainty in the participant's own capability to perform that practice, or self efficacy. Self-efficacy can play a large role in both teacher and student performance (Pihie and Bagheri, 2011), can differ across gender (Beyer, 1990), and can influence and interact with decisions affected by external risks (Cox et al., 2008; Crosby et al., 2001). Overall, our study involves 1,966 farmers, all of whom are women. Thirty five percent were assigned to the control consisting of NLRM training, and 65 % were assigned the treatment group consisting of NLRM training and a DG video exposure. Within the DG treatment arm, 25% were shown only the regular DG video on SRI, 25% were shown an additional clip on labor costs (uncertainty), 25% were shown an additional clip on farmer success rates (self efficacy), and 25% were shown both add-on clips.

We find that the overall impact of our video-based training is positive and significant on adoption, for our sample between 2014 and 2015. Viewing the DG videos increases the probability of adoption, by 0.058, where average adoption between control and treatment groups is 0.14, or 14% (10% for the control and 16% for the treatment group). Thus increase the probability of adoption from 0.10 to 0.15 is a fifty percent increase for the the control group in adoption rates (16% of a standard deviation).[4]

This paper is organized as follows: Section 2 provides background on the research context, including the Digital Green and its operations in Section 3. Section 4 reviews System of Rice Intensification and our reasoning behind choosing to study its adoption. Section 5 describes the data and study design in the RCT framework. In Section 7 we examine the evidence for increased adoption in our sample. Section 8 concludes.

2 Context

The study took place in Bihar, India across three districts: Nalanda, Muzzafapur, and Purnia–three northern districts where rice and wheat are the primary rainfed crops and where modern irrigation and canal water remain minimal. The baseline began in June 2014, the sideline in August 2014 and the enplane in January 2015.[5]

Bihar is one of the poorest states in India, with per capita GDP at 28317 INR (440 USD) per year, or about 1.20 USD per day. Bihar saw some of lowest poverty reduction during the Green Revolution with female farmers being worst off (Ravallion and Datt, 2002). Their responsibilities are stretched across cultivation and family; they are rarely able to maintain their earnings, nor do they receive training from extension agents. The stagnation of half a population not only contributes to poverty today, it exacerbates the poverty trap and the gender gap in the future. Women will continue to face lower yields, lowering their incomes and bargaining power, further reducing their ability allocate resources to their family and children, who will then realize less than their full potential. As such Digital Green works through existing formal structures called self-help groups (SHGs), which were initiated by the State of India and implemented by the state of Bihar. SHGs are small groups of individuals, in the order of 10-20 individuals, who meet regularly with a local VRP. DG then partners

---

[4] The study is ongoing and we will have an additional 2,015 midline and 2,016 endline to test for the training's long term effects.

[5] The study will continue for an additional year with a second midline in August 2015 and second endline in January 2016. We will test for the longer term impacts of DG as well as aspects regarding male inclusiveness in the adoption process.

with local SHGs to bring screen DG content to the SHG meeting on a weekly basis.

In rural Bihar, agriculture remains the primary livelihood of individuals, and is key to is improving well being at the individual level, but also to food security more generally. Global consumption, increasing population, climate variability and climate change threaten agricultural based livelihoods in the developing-world, as well as international security. There is increasing evidence of the economic impacts of climate risk on agriculture (Dinar et al., 1998; Guiteras, 2009; Mendelsohn, 2005), while the prevalence of natural disasters has risen in developing countries at twice the global rate (Walter et al., 2004). In countries like India, where agriculture provides nearly 48% of employment and comprises roughly 20% of GDP (FAO 2011), a lack of adjustment in agricultural practices to climate change can lead to failed harvests and significant impacts for society globally. Recent crop failures and rising food prices have led to protests and riots around the world, and in international policy circles, it is widely accepted that instability due to food security is a rising global concern (Oxf, 2012).

Typical agricultural training is delivered by extension agents, paid for by local or national governments, or NGOs. The prevalent agricultural extension programs in developing countries can be costly, slow, and ineffective. Classical training & visit (T&V) programs generally involve an extension worker traveling from village to village, door to door, and speaking with a select number of individuals in a village, usually males who own larger farms (Anderson et al., 2006). Farmers may be slow to adopt external extension trainers' techniques due to several factors: external agents often do not possess location specific knowledge, their visitation can be infrequent and erratic, and their information rarely reaches farmers with the lowest yields, who often are women (FAO 2010). Alternatives to T&V, such as "Farmer Field Schools" are believed to have a better impact, but at a dramatically greater cost (Tripp et al., 2005). Cost-effective solutions are rare.

Compound this issue with low literacy rates: 69% for males and 49% for females. Therefore, training must improve the knowledge of farmers, while accounting for constraints in farmer accessibility and comprehension. In many cases, it is the already educated and well trained who receive further training, exacerbating any inequalities in production, and further marginazlizing those on the periphery of the village network. Thus the problem is two fold: there is a need to directly target and address the vulnerable population, and there is a need for educational materials that are comprehensive, understandable, and scalable. This is where Digital Green is well positioned to address both these issues. It is one of the few methodologies that use technology to streamline and scale training, while relying on organic social structures through which accessing and connecting to such farmers is possible.

3 Digital Green

DG was founded as an NGO in 2008, and originated out of research at Microsoft Research India, which began in 2006 (Gandhi et al., 2009). In addition to traditional computing research, MSR India also builds and tests platforms that are conducive to local users' needs, particularly with regards to general literary and mobile literacy in India. Digital Green was one of MSR India's most successful projects in the field. Its success is attributed to the fact that DG amplifies human efforts and knowledge rather than aiming to replace or mimic it.

Digital Green uses commodity video technology to create short how-to videos featuring local farmers executing new practices. The videos are then used as the basis for mediated instruction which a group of farmers gather to watch and discuss. Originally developed by a blue-sky corporate research laboratory, the methodology is now in the care of the Digital Green Foundation and Trust, a non-profit organization with offices in California and Delhi. The non-profit partners with and trains other organizations that disseminate agriculture technologies and techniques to smallholder farmers in developing countries. The videos; sequencing and prompts, portability of projectors and the ongoing training of trainers makes the approach cost effective and scalable. Digital Green now displays hundreds of videos on various agricultural practices by state, language, and crop. Similar to Kahn Academy's repository around STEM, Digital Green maintains a library of videos focused on the latest agricultural practices at digitalgreen.org.

Digital Green's video style and content were generated from an iterative approach with the farmers for whom it was originally developed. A few key aspects emerged from this testing period, including the fact that farmers preferred to see and hear information coming from farmers similar to themselves as opposed to trainers or government officials; they preferred seeing multiple farmers and multiple locations throughout the video; demonstrations were crucial; pausing and interaction during the video as well as play-backs were key, but the mediation was indispensable for getting a farmer to even sit through an entire video (Gandhi et al., 2009). This information alone tells us how important human mediation in simply holding the attention and trust of farmers regarding information that would be otherwise freely available.

In 2011, India's National Rural Livelihood Mission was launched, a program of India's Ministry of Rural Development at the national level, and supported by the World Bank. NLRM aimed to organize the poor into Self Help Groups (SHGs) and promote self-employment skills via SHGs. SHGs have existed since the late 1990's, but they were not stable or effective until they were re-launched under the NLRM program, which aimed to establish the groups alongside poverty alleviation programs. Villages typically have several SHGs that are meant to be unified under a federation of SHG groups. As NLRM was developed, DG's work naturally came to interact with NLRM's efforts. As such, they began to coordinate their efforts.[6] DG and NRLM are partnering to propagate a series of agricultural techniques previously identified by NRLM and its predecessors to be effective in increasing yields and incomes for smallholder farmers. The partnership aims to impact 30,000 villages within the next five years. The DG-NRLM partnership provided a perfect opportunity to study DG's impact over more traditional extension methodologies, as well as to better understand what makes DG effective and how to enhance it further.

Observational data had been collected over time on villages and villagers who adopted the DG method. DG follows and tracts all of its viewers via its databased management platform, Connect Online Connect Offline (COCO). Real time dissemination and adoption can be viewed on their public analytics platform. However, a simple comparison of DG adopters to non-adopters would capture the impact of DG in addition to any existing differences between farmers and villages across the two groups. A RCT methodology circumvents theses biases by randomly assigning which villages would be offered the DG viewings, such that the option

---

[6] Therefore, all control groups in our study are subject to NLRM's SHG organization and any training that they may provide.

to view the video is not correlated with any observable (e.g. age, income, education) or unobservable (e.g. ability, networking) characteristics. Hence, a randomized trial, conducted in new areas where farmers had not yet been exposed to DG, provided the cleanest approach. Furthermore, any ethical concerns that the control group would be denied the potential benefits of DG were small since there is every intention to roll out both NLRM and DG, to the reminder of the Bihar state, but it is a matter of time and resources until they can do so. Therefore, the intervention did not change DG's intended reach in Bihar, but only (randomly) defined the order in which villages receive the training over time.

3.1 Information treatments: inputs versus self-efficacy

Even with effective training and dissemination of information, uptake of new practices can often be slow by farmers, especially at the on-start. Focus group meetings with DG participants suggest that some of the challenges with adoption of SRI incomplete information around the costs of the new technology particularly with respect to labor, and that farmers perceive the SRI technique as beyond their capability.

Jan (2011) shows that the number of potential adopters of agricultural practices is often smaller than we think. The problem may due to host of inefficiencies: information, risk, input, credit, labor, and risk (Kelsey, 2013). There have been fewer studies of self-efficacy in the context of agricultural practices (Shefner et al., 1998), but self-efficacy has been found to be strongly correlated with behavioral change in health (Strecher, Devellis, Becker, and Rosenstock, Strecher et al.). We focus on providing messages around labor costs and farmers' self-efficacy may be one way to expedite the adoption process, which we would like to test.

4 SRI

The technology that we focus on in this study is System of Rice Intensification (SRI). SRI is an agronomic technique that increase gross yield, typically, with fewer inputs (ICRISAT 2008). In particular, SRI significantly less water than traditional rice cultivation methods and has been shown to increase yields at the same or few necessary inputs (Dobermann, 2004; Noltze et al., 2012; Sinha and Talati, 2007; Takahashi and Barrett, 2013; Thakur et al., 2010)

Rice is a water intensive crop, and SRI has been show to reduce irrigation water from 22% (Thakur et al., 2010) to as much as 45% (Sinha and Talati, 2007). In addition to reducing water requirements, SRI reduces the need for input of seeds, fertilizers and pesticides, while increasing yields by as much as 48% (V&A Program 2009, Thakur et. al. 2011). The key component to SRI's success is the transplanting of young seedlings at an earlier stage than conventional practices suggest, and at a wider spacing between seedlings. This allows the seedlings' roots to grow larger in soil that is kept well aerated (ICRISAT 2008). There are several steps to SRI that contribute to higher yields: seed treatment[7], nursery bed

---

[7] Paddy seeds are put in salt/brine solution; They are washed 3-4 times with fresh water to remove salt contents; Seeds are kept soaking in normal water for 18 hours; Seeds are treated with Bevastin powder; Sees are kept in roped sack for 24 hours in shade and sprayed with water twice daily.

cultivation[8], later transplantation[9], and the use of a conoweeder.[10]

SRI is a particularly relevant technique in the context of climate change, and the stresses that climate change exerts on hydrological systems, and on already scarce groundwater resources in semi-arid areas in India, which are also characterized by low and often erratic rainfall (Gulati and Kelley, Gulati and Kelley; Ribot, Ribot). However, adoption of SRI practices remain low at only 30 % of the existing rice farmers in the state of Bihar, India, where our proposed RCT will take place. One of the most frequently cited concerns is the potential increase in labor needed to carry out the practice. However, the increased yields by 10% or more (Uphoff, 2005; Verma et al., 2014; Wu et al., 2015), far outweigh the potential labor costs. This is what we address in our sub-treatment regarding farmers' uncertainty around the technique. Our two sub-treatments append messages that address both the average labor costs for implementing SRI as well as messages from farmers who had implanted SRI encouraging others to adopt the practice. See the Appendix for the exact text

5 Data and Design

The data were collected by the Jameel Poverty Action Lab South Asia.[11] The baseline began in May 2014 before the mandated transplantation data of June 15th in India. The midline took place in August-September 2014, and the enplane occurred between January and March 2015.

The trial was conducted over 420 total villages (treatment and control), with 6 surveyed participants per village. Each of those 6 individuals belonged to a SHG of 15 to 20 individuals. Villages were selected across three districts in the state of Bihar: Nalanda, Purnia and Muzzafapur. The districts were selected as areas where NRLM was present, but where there were a significant number of blocks within each district where DG had not been introduced. We have a large overarching RCT (control versus DG), and within the DG treatment group, we nested the two additional information treatments, each occurring orthogonally within the sample. Because of the orthogonal nesting in the DG villages, for all four hypotheses, we will have at least 140 control and 280 treatment villages.

- T0: NRLM (33% of sample; 140 villages)

---

[8] Field if ploughed four times to remove grass and weeds; For 1 acre field, 6 beds of paddy seeds are planted with each bed being 30 ft in length, 5 ft of width, and 6 inch in height; Drains are prepared that are1.5 ft wide and 6 inch high around each of the nursery beds; Each bed is covered with a mixture of 2-3 baskets of vermicompost and 400 gms PSB/6; The treated seeds are then spread (2kg/6) on nursery beds and covered with vermicompost followed by a spreading of straw.

[9] SRI requires 4-5 ploughings before preparing the land; Sees are removed with the soil from the nursery bed; Seedlings from the nursery are transplanted with mud on its roots very carefully by using a spade and plate; The seedlings should be 8-14 days old; Each individual seedling is transplanted maintaining the proper spacing; Drains on the 4 sides of the main field remove excess water; The time between removing seedlings and transplantation should not be more then 30 mintues.

[10] Before weeding, farmers irrigate the paddy field a day before so that an inch of water remains; The conoweeder should be used twice within 15 days of transplantation; The space between rows of paddy should be 10 inch when applying the conoweeder.

[11] Led by JPAL personnel: Urmi Bhattacharya, Tushi Baul, Mohak Mangal, and Abhinav Khemka

- T1: DG (67% of sample; 280 villages)
    - T1a: Regular DG videos (1/4 of 67%, 70)
    - T1b: DG videos + labor-cost information (1/8 of 67%, 70)
    - T1c: DG videos + self-efficacy information (1/8 of 67%, 70)
    - T1d: DG videos + labor-cost information + self-efficacy information (1/4 of 67%, 70)

[12]

6 Motivational Model

Assuming that farmers are risk averse, we choose preferences to be log linear in profits. $U(\pi) = log(\pi)$, where profits are equal to revenue, r, less labor costs, w, less any new adoption costs, c, $\pi = r - w - c$. Revenue and labor costs are stochastic, and profits are stochastic and normally distributed $N(\mu, \sigma^2)$.

Using a first order Taylor approximation of log preferences evaluated at mean income E(π), utility can be expressed as $U(\pi) = log(E(\pi)) - \frac{Var(\pi)}{2E(\pi)^2}$. Substituting in the expression for profits, we can see that the farmer will choose to adopt SRI in expectation if:

$$log(\mu_{\pi,SRI}) - \frac{\sigma^2_{\pi,SRI}}{2\mu^2_{\pi,SRI}} > log(\mu_{\pi,NLRM}) - \frac{\sigma^2_{\pi,NLRM}}{2\mu^2_{\pi,NLRM}}$$

$log(E(\pi^{SRI})) > log(E(\pi^{NLRM}))$, or substituting in profits, a farmer will adopt SRI in the control group if:

$\mu^{SRI} - c - \frac{1}{2}\frac{\sigma_r^{SRI}+\sigma_w^{SRI}}{(\mu^{SRI})^2} > \mu - \frac{1}{2}\frac{\sigma_r+\sigma_w}{(\mu)^2}$

and will adopt SRI in the treatment group, which aims to reduce variance and increase the mean output:

$\delta_\mu\mu^{SRI} - c - \frac{1}{2}\frac{\delta_r\sigma_r^{SRI}+\delta_w\sigma_w^{SRI}}{(\delta_\mu\mu^{SRI})^2} > \mu - \frac{1}{2}\frac{\sigma_r+\sigma_w}{(\mu)^2}$

The question is whether this is a story of adoption costs, c, or risk around revenues or labor costs. Our intervention is purely a one of information above and beyond the control group. This is in contrast to farmer interventions that are transfer based Bryan et al. (2014); Karlan et al. (2014).

7 Empirical Estimation of Program Effects

We implemented a survey that asked respondents to state whether they had adopted SRI, along with household demographics, plot and paddy cultivation details, land ownership,

---

[12] These calculations were based on Type I error of 5% and Type II error of 80%, a clustering coefficient of 5%, an expected effect size of 8% increase in adoption of SRI, and 2 treatment groups.

familiarity with SRI, perceptions on costs of SRI, paddy practices, labor and input use in paddy cultivation, water sufficiency, agricultural extension, expenditures, self efficacy and aspirations.

The following results are preliminary and present the basic estimates of our treatment effects without controls using the midline data.[13] We first present, in Table 1, a balance table, comparing observable variables between treatment and control groups, showing that our groups show no major statistical differences on observables. Hence, we believe our randomization between treatment and control was successful along the dimensions of education, income, asset ownership, and size of household. In Table 1 we report marginal effects of the intervention using both OLS and Probit (which yield comparable marginal effects).

$$\text{SRI adoption} = \alpha + \beta_1 T_1 + \beta_2 T_2 + \beta_3 T_3 + \epsilon$$

where ϵ is assume to be normal, and we cluster our standard errors at the village level, correcting for any correlation between neighbors within a village.

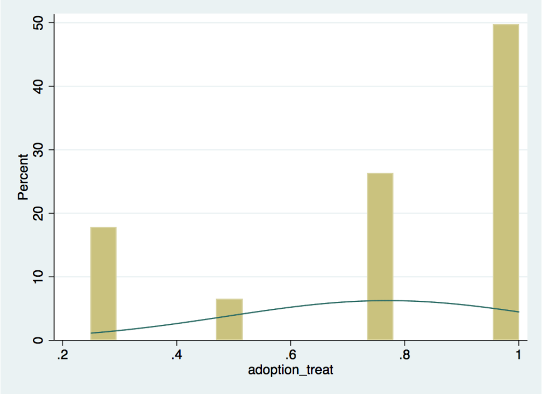
We find that the the direct impact of the DG training is positive and significant, showing that DG training has additive value above and beyond the control group. In Table 2, Column 1 we measure the intent to treat (ITT), ignoring the fact that several of the villages that were scheduled to view a DG video failed to receive the viewing. Here the outcome is our indicator of whether the village was assigned to the DG treatment, but not if they actually viewed the videos. Thus, the estimate is a lower bound of the effect of DG training. We find that the overall effect is 0.059, or that being assigned to the DG treatment increased the probability of adoption by 0.058. This is a significant economic effect, given that the average adoption rate is 14%, and is 10% in the control, and 16% in the treatment group. For the control group, a 0.05 increase, is thus over a 50% increase in the probability of adoption the SRI technology. In Column 2 we measure the treatment on the treated (ITT), breaking down the treatments: DG only, DG + labor cost add-on, DG + self efficacy add-on, and DG+ labor + self-efficacy add-ons. Here we see that the treatment labor cost add-ons had the greatest effect, increasing the probability of adoption by 0.075, followed by the combined video effect of 0.062, and the DG + self- efficacy effect of 0.037. The latter tells us that self-efficacy has an effect on adoption, but the effect was muted. We found that the messaging and survey questions with regards to self-efficacy were the most difficult to administer. Capturing self-efficacy in the survey proved to be quite difficult, and this warrants further research on how to best affect farmers' perceptions of their own potential in this cultural context.

7.1 Adoption Index

Density of Adoption Stages for Adopters

---

[13] We are currently working to clean and use the full panel data from the baseline midline and enplane, as well as incorporate controls from the many modules within the survey, which are being cleaned.



In addition to studying self reported adoption, we also investigate how the DG videos affected an adoption index - which delineates each stage of adoption separately. The adoption index is not cumulative and is comprised of four stages of SRI: seed treatment, bag treatment, nursery preparation, and transplantation. For example, if two of these stages are adopted then the index value is one half.

Tables 2 shows that the overall DG treatment had its greatest effect on the transplantation stage, followed by the seed treatment stage. This is not too surprising for several reasons. First, the videos began after the seed treatment stage. Secondly, the labor arm spoke most directly to the transplantation phase, as that is the phase that requires the greatest increase in labor inputs. Table 3 breaks down DG into its sub treatments. Here we can see that the DG videos with added labor segments had the greatest overall impact on the transplantation stage. One thing to note however, is that that coefficients on the sub treatments are not statistically different.

We also show preliminary results of the DG video on yields. We note that few farmers reported their yields as being produced under the SRI approach (135) versus the 1,270 individuals who reported yields via the traditional method. Tables 4 indicates that yields for Traditional growers increased by around 300 kilograms per acre from the DG videos. This suggest that some steps from the DG videos were adopted, and confirmed by our index. Thus, partial adopters did not consider themselves as having adopting SRI or growing paddy via the SRI technique.

8 Conclusion

Our research estimates the effects of a video-based intervention that integrates into and amplifies an existing training framework. The features of the videos follow a common framework wherein a local farmer exposits a new technique within 15-30 minutes in outdoor onsite setting, and a village representative moderates the video intermittently pausing to field participants' questions. The research design tests for the overall impact of the videos as well as video add-ons regarding uncertainty around the technology's costs as well as the uncertainty around own self-efficacy. Our estimates for treatment on the treated as well as the intent to treatment are positive and significant. We find that participants respond positively to messages regarding external uncertainty (labor costs) around adopting the the new technology, but less so to our messages regarding their own self-efficacy. There are several potential reasons as to why a self-efficacy messaging failed to produce larger results: message framing was complicated by the fact that the message had to be general enough to relate to all village scenarios, the protagonist in each video may have been perceived as more capable than the viewer herself, and it was culturally difficult to capture respondents' feelings regarding their own self-efficacy in the survey.

These results suggest that training via videos, which relate to viewers' social norms and experiences, and are also mediated by local farmers, can serve as a feasible and scaleable method for improving agricultural outcomes for some of the poorest individuals in rural India. It also suggests that directly addressing some of the uncertainties around a technology, in terms of costs and benefits, increases take-up above and beyond standard training. Finally, future work should develop a greater understanding of how to better touch upon participants' own self-efficacy–potentially via other farmers or family members, as well as if this training methodology extends to other self organized groups that are interested in the adoption of health practices or information communication technologies.

References

(2012). Averting Tomorrow's Global Food Crisis. *Oxfam Briefing Note, March, 2012*.

Aker, J. C. (2011). Dial "A" for agriculture: A review of information and communication technologies for agricultural extension in developing countries. *Agricultural Economics 42*(6), 631–647.

Anderson, J. R., G. Feder, and S. Ganguly (2006). The Rise and Fall of Training and Visit Extension: An Asian Mini-drama with an African Epilogue. *Working Paper* (May).

Anthes, E. (2015). The trouble with Checklists: An easy method that promised to save lives in hospitals worldwide may not be so simple after all. *Nature 523*, 6–8.

Bahal, R. (2004). *Agricultural Research and Extension Systems: Worldwide Study of Human and Financial Resources*. Delhi: Concept Publishing Company.

Bandiera, O. and I. Rasul (2006). Social Networks and Technology Adaption in Northern Mozambique. *The Economic Journal 116*(July 2001), 869–902.

Bandura (2000). Exercise of Human Collective Efficacy Agency Through. *9*(3), 75–78.

Bandura, a., C. Barbaranelli, G. V. Caprara, and C. Pastorelli (1996). Multifaceted impact of self-efficacy beliefs on academic functioning. *Child development 67*(3), 1206–1222.

Barham, B. L., J. P. Chavas, D. Fitz, V. R. Salas, and L. Schechter (2014). The roles of risk and ambiguity in technology adoption. *Journal of Economic Behavior and Organization 97*, 204–218.

Barrera-Osorio, F. and L. L. Linden (2013). *The Use And Misuse Of Computers In Education: Evidence From A Randomized Experiment In Colombia*. Washington DC: The World Bank Group.

BenYishay, A. and A. M. Mobarak (2014). Social learning and communication. *NBER Working Paper No. 20139* (20139).

Beyer, S. (1990). Gender Differences in the Accuracy of Self-Evaluations of Performance. *59*(5), 960–970.

Breza, E. (2014). Peer effects and loan repayment: Evidence from the krishna default crisis. *Working Paper, MIT*.

Bryan, G., S. Chowdhury, and A. M. Mobarak (2014). Under-investment in a profitable technology: The case of seasonal migration in Bangladesh.

Bursztyn, L., F. Ederer, B. Ferman, and N. Yuchtman (2014). Understanding mechanisms underlying peer effects: Evidence from a field experiment on financial decisions. *Econometrica, Forthcoming*.

Cohen, J. (2014). The Impact of Packaging and Messaging on Adherence to Malaria Treatment : Evidence from a Randomized Controlled Trial in Uganda ?

Cohen, J. L., E. Yavuz, A. Morris, J. Arkedis, and O. Sabot (2012). Do patients adhere to over-the-counter artemisinin combination therapy for malaria? evidence from an intervention study in Uganda. *Malaria Journal 11*(1), 83.

Cole, S. a. and a. N. Fernando (2012). The Value of Advice: Evidence from Mobile Phone-Based Agricultural Extension. pp. 1–33.

Conley, T. G. and C. R. Udry (2010, March). Learning about a New Technology: Pineapple in Ghana. *American Economic Review 100*(1), 35–69.

Cox, J., P. De, C. Morissette, C. Tremblay, R. Stephenson, R. Allard, and L. Graves (2008). Low perceived benefits and self-efficacy are associated with hepatitis C virus (HCV) infection-related risk among injection drug users. *66*, 211–220.

Cristia, J. P., P. Ibarrarn, S. Cueto, A. Santiago, and E. Severn (2012). Technology and child development: Evidence from the one laptop per child program. *Institute for the Study of Labor 6401.*

Crosby, R., R. J. DiClemente, G. M. Wingood, C. Sionean, B. K. Cobb, K. Harrington, S. Davies, E. W. Hook, and M. K. Oh (2001). Correct condom application among African-American adolescent females: The relationship to perceived self-efficacy and the association to confirmed STDs. *Journal of Adolescent Health 29*(3), 194–199.

de Melo, G., A. Machado, A. Miranda, and M. Viera (2013). Impacto del plan ceibal en el aprendizaje. evidencia de la mayor experiencia olpc. *del Instituto de Economa (IECON).*

Dinar, A., R. Mendelsohn, R. Evenson, J. Parikh, K. Kumar, and J. Mckinsey (1998). Measuring the Impact of Climate Change on Indian Agriculture. *Worldbank.*

Dobermann, a. (2004, March). A critical assessment of the system of rice intensification (SRI). *Agricultural Systems 79*(3), 261–281.

Duflo, E., M. Kremer, and J. Robinson (2010). No Title. (October).

Fafchamps, M. and B. Minten (2012). Impact of SMS-based agricultural information on Indian farmers. *World Bank Economic Review 26*(3), 383–414.

Feder, G., R. Murgai, and J. B. Quizon (2004). The Acquisition and Diffusion of Knowledge: The Case of Pest Management Training in Farmer Field Schools, Indonesia. *Journal of Agricultural Economics 55*(2), 221–243.

Field, E., B. Feigenberg, and R. Pande (2013). The economic returns to social interaction: Experimental evidence from microfinance. *Review of Economic Studies 80*(4), 1459–1483.

Food and Agriculture Organization (2011). *The State of Food and Agriculture. Women in Agriculture: Closing the Gap for Development*, Volume 2.

Galarza, F. B. (2009). Choices under Risk in Rural Peru. pp. 1–53.

Gandhi, R., K. Toyama, R. Veeraraghavan, and V. Ramprasad (2009). Digital Green : Participatory Video and Mediated Instruction for Agricultural. *Information Technologies and International Development 5*(1), 1–15.

Guiteras, R. (2009). The Impact of Climate Change on Indian Agriculture. (September).

Gulati, A. and T. Kelley. In *Semi-Arid Tropics*.

Harou, A. and C. B. Barrett (2014). Variable Returns to Fertilizer Use and Its Relationship to Poverty Experimental and Simulation Evidence from Malawi. (September).

Jamison, J. C., D. Karlan, and P. Raffler (2013). Mixed Method Evaluation of Passive Health Sexual Information Texting Service in Uganda.

Jan, M. (2011). Message-Oriented Farmers and Potential Adopters of Agricultural Technology The Case of Khyber PakhtunKhawa (KPK) Pakistan. *52*(4), 461–469.

Karlan, D., M. Morten, and J. Zinman (2012). A personal touch: Text messaging for loan repayment. (February), 1–17.

Karlan, D., R. Osei, I. Osei-Akoto, and C. Udry (2014). Agricultural Decisions after Relaxing Credit and Risk Constraints. *The Quarterly Journal of Economics 129*(2), 597–652.

Kelsey, J. B. (2013). Market inefficiencies and the adoption of agricultural technologies in developing countries. *Agricultural Technology Adoption Initiative, J-PAL (MIT) and CEGA (UC Berkeley)*, 1–69.

Linden, L. L. (2008). Complement or substitute? the effect of technology on student achievement in india. *World Bank Working Paper* (17).

Mani, A., S. Mullainathan, E. Shafir, and J. Zhao (2013, August). Poverty impedes cognitive function. *Science (New York, N.Y.) 341*(6149), 976–80.

Mendelsohn, R. (2005). Methods.

Munshi, K. (2004). Social learning in a heterogeneous population: Technology diffusion in the Indian Green Revolution. *Journal of Development Economics 73*(1), 185–213.

Murphy, R., L. Gallagher, A. Krumm, J. Mislevy, A. Hafter, and M. Park (2014). Research on the Use of Khan Academy in Schools. (March).

Nakasone, E., M. Torero, and B. Minten (2014). The Power of Information: The ICT Revolution in Agricultural Development "Power of Information". *Researchgate.Net*.

Noltze, M., S. Schwarze, and M. Qaim (2012, April). Understanding the adoption of system technologies in smallholder agriculture: The system of rice intensification (SRI) in Timor Leste. *Agricultural Systems 108*, 64–73.

Pihie, Z. a. L. and A. Bagheri (2011). Teachers' and students' entrepreneurial self-efficacy: Implication for effective teaching practices. *Procedia - Social and Behavioral Sciences 29*, 1071–1080.

Ravallion, M. and G. Datt (2002). Why has economic growth been more pro-poor in some states of India than others? *Journal of Development Economics 68*(2), 381–400.

Ribot, J. Climate Variability, Climate Change and Vulnerability. In S. Ribot, J.C., Magalhães, A.R. and Panagides (Ed.), *Moving Forward by Looking Back*. Cambridge University Press.

Shefner, R., N. Rao, E. Rogers, and A. Wayangankar (1998). The Empowerment of Women Dairy Farmers in India. *Journal of Applied Communication Research 26*, 319–337.

Sinha, S. K. and J. Talati (2007, January). Productivity impacts of the system of rice intensification (SRI): A case study in West Bengal, India. *Agricultural Water Management 87*(1), 55–60.

Strecher, V. J., B. M. Devellis, M. H. Becker, and I. M. Rosenstock. The Role of Self-Efficacy in Achieving Behavior Change Health.

Takahashi, K. and C. B. Barrett (2013, November). The System of Rice Intensification and its Impacts on Household Income and Child Schooling: Evidence from Rural Indonesia. *American Journal of Agricultural Economics 96*(1), 269–289.

Thakur, A. K., S. Rath, D. U. Patil, and A. Kumar (2010, November). Effects on rice plant morphology and physiology of water and associated management practices of the system of rice intensification and their implications for crop performance. *Paddy and Water Environment 9*(1), 13–24.

Toyama, K. (2015). *Geek Heresy: Rescuing Social Change from the Cult of Technology*. New York: Public Affiairs.

Tripp, R., M. Wijeratne, and V. H. Piyadasa (2005, October). What should we expect from farmer field schools? A Sri Lanka case study. *World Development 33*(10), 1705–1720.

Uphoff, N. (2005). Rice intensification system is showing many benefits. *Appropriate Technology 32*(4), 34–37.

Verma, A. K., N. Pandey, and G. K. Shrivastava (2014). Production Potential and Economics of Hybrid Rice Under System of Rice Intensification and its Manipulation. *12*(2), 71–78.

Walter, J., E. von Oelreich, J.-C. Chamois, A. Duggal-Chadha, and S. Marin-pache (2004). World Disasters Report. Technical report, International Federation of Red Cross and Red Crescent Societies.

Wu, W., B. Ma, and N. Uphoff (2015). A review of the system of rice intensification in China. *Plant and Soil*, 361–381.

Xu, D. and S. S. Jaggars (2013). The impact of online learning on students' course outcomes: Evidence from a large community and technical college system. *Economics of Education Review 37*, 46–57.

Table 1: Balance on Observables

	meanC	meanD	sdC	sdD	pval
Respondent Age	39.8	40.1	12.5	12.6	0.61
Relation to HH Head	1.3	1.3	1.4	1.5	0.14
Respondent Education	1.6	1.5	3.1	3.1	0.64
Family Size	7.1	6.9	3.3	3.2	0.2
HH Head Education	3.8	3.9	4.4	4.5	0.74
HH Head Age	46.5	47.3	13.2	13.2	0.17
HH Head Religion	1.1	1.1	0.3	0.3	0.64
Plot size	6.8	6.9	6.9	5.9	0.6
Unit of Plot	2.9	2.9	0.3	0.3	0.96
Soil quality of largest plot	1.5	1.5	0.6	0.6	0.4
Water source	1.1	1.1	0.4	0.4	0.22
Percent plot irrigated 2014	99.5	99.4	7	6.3	0.87
Annual Income	54,783.20	52,834.70	62,721.90	55,411.00	0.44
Has Motorcyle	1.9	1.9	0.2	0.3	0.29
No. Motorcyles	1	1	0.3	0.1	0.48
Has Stove	1.8	1.8	0.4	0.4	0.29
No. Stoves	1.1	1.1	0.3	0.3	0.76
Has Mobile Phone	1.1	1.2	0.3	0.4	0.13
No. Mobile Phones	1.3	1.3	1.1	0.7	0.49
Has Water Tank	2	2	0.1	0.1	0.79
No. Water Tank	1.3	1.1	0.5	0.3	0.56
Has Water Pump	1.9	1.9	0.3	0.3	0.5
No. Water Water Pump	1.1	1.3	0.4	1.1	0.14
Has Tractor	2	2	0.1	0.1	0.81
No. Tractor	1	1.2	-	0.4	0.2
Has Cow	1.6	1.6	0.5	0.5	0.39
No. Cows	2	1.9	1.6	1.1	0.31
Has Buffalo	1.5	1.6	0.5	0.5	0.44
No. Buffalos	1.8	1.8	1	0.9	0.47
Has Goat	1.4	1.5	0.5	0.5	0.08
No. Goats	2.5	2.4	1.7	1.7	0.21
Has Hen	1.9	1.9	0.3	0.3	0.97
No Hens	5.6	5.4	4.8	11.4	0.9
Has Pig	2	2	0.1	0.1	0.52
No Pigs	1	1.7	-	1.7	0.52
Kgs rice Eaten last 30 days	49.2	48.8	23.8	23.3	0.7
Kgs wheat Eaten last 30 days	48.1	47	23.8	24.2	0.26
Kgs meat Eaten last 30 days	1.2	1.2	0.4	0.4	0.71
Kgs fish Eaten last 30 days	1.2	1.2	0.4	0.4	0.78
No Children went to school last 30 days	1.9	1.9	0.5	0.6	0.61
Amount spent on medical care last 30 days	4,703.20	5,082.40	8,139.10	12,403.70	0.43

Table 2: Effect of Video Training on SRI Adoption

VARIABLES	(1) Intention to Treat (ITT)	(2) Nested ITT
DG0, SRI Video		0.0591*
		(0.0924)
DG1, SRI Video + Labor Cost Clip		0.0752**
		(0.0418)
DG2, SRI Video + Self Efficacy Clip		0.0374
		(0.271)
DG3, SRI Video + Labor Cost + Self Efficacy Clip		0.0629*
		(0.0851)
Intention to treat	0.0589**	
	(0.0114)	
Self_reported_treatment		
DG_reported_treatment		
Constant	0.109***	0.109***
	(4.70e-10)	(4.84e-10)
Observations	1,966	1,966
R-squared	0.006	0.007

cluster robust pval in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 3: Nested treatments on adoption stagest

VARIABLES	(1) Seed	(2) Bag	(3) Nursery	(4) Transplantation	(5) Weeding
DG ITT	0.0378*	0.0115	0.0266	0.0588**	-0.0115
	(0.0843)	(0.521)	(0.179)	(0.0219)	(0.170)
Observations	1,926	1,926	1,926	1,926	1,926

cluster robust pval in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 4: Treatments on adoption index and adoption stages

VARIABLES	(1) Index	(2) Index	(3) Seeds	(4) Bags	(5) Nursery	(6) Transplantation	(7) Weeder
DG		0.0363	0.0434	0.0113	0.0334	0.0573	0.00243
		(0.179)	(0.134)	(0.613)	(0.213)	(0.106)	(0.865)
DG + labor		0.0451	0.0457	0.0267	0.0390	0.0689*	-0.0137
		(0.136)	(0.146)	(0.324)	(0.195)	(0.0679)	(0.230)
DG + self efficacy		0.0167	0.0175	0.00359	0.0104	0.0354	-0.0262***
		(0.544)	(0.542)	(0.888)	(0.691)	(0.302)	(0.00790)
DG + both		0.0315	0.0388	0.00369	0.0205	0.0631*	-0.0118
		(0.265)	(0.207)	(0.879)	(0.456)	(0.0874)	(0.385)
ITT	0.0338						
	(0.103)						
Observations	1,926	1,926	1,926	1,926	1,926	1,926	1,926

cluster robust pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Preliminary results on Yields

VARIABLES	(1) SRI Yield	(2) Traditional Yield	(3) Total Yield
DG	-36.82	326.7**	112.5
	(0.724)	(0.0220)	(0.877)
DG + labor	-12.25	96.52	158.2
	(0.927)	(0.424)	(0.779)
DG + self efficacy	-54.35	-10.25	211.8
	(0.606)	(0.908)	(0.710)
DG + both	47.65	87.34	687.8
	(0.744)	(0.490)	(0.299)
sri_area	538.7**		
	(0.0195)		
trad_area		114.3	
		(0.124)	
total_area			1,484***
			(5.68e-06)
Observations	135	1,270	82

cluster robust pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1

9 Appendix A: Subtreatments

Appendix A: Script for Clip (a) Below is the suggested script for Clip (a) ? short (30-60 seconds) clip in which actual labour costs of SRI per unit area (e.g., katha).

Video producers should feel free to revise language, tone, labour-cost information, and actor. The goal is a short, informative clip that indicates what the labour costs of SRI actually are on a per-area basis.

Recommended actor type: Same actor as in current videos– a woman who has successfully tried SRI in the past. [Alternate actor type: Someone who would be respected by local farmers for their agriculture knowledge, and who can speak knowledgeably about SRI.]

Dress: Actor is dressed in normal clothes worn for farming activities.

Background: Actor is standing in front of their well-stocked store of rice, or in front of a neutral background (such as a house, or a farm, or a forest). They look directly into the camera when speaking.

Script: "Our household has been using SRI for paddy for several years. At first, we were worried that it would take more labour than traditional paddy, so we tried it in a corner of one of our plots of land. For [topic of the video], we found that SRI requires about [X more/less] days of labour compared with traditional method. And over the entire planting cycle, there was only a total of [one day more] of labour per katha for SRI over traditional. For that we gained over [50kg] more rice per katha with SRI, which even at [Rs. 10] per kg would be [Rs. 500] more in value per katha. Because of this, SRI is worth the little bit of extra labour, and we will plant using SRI again this year."

Instructions to VRPs: After this section of the video plays, the VRPs should pause the video and ask the audience questions about the labour costs of SRI, both for this topic, and overall for SRI.

Appendix B: Script for Clip (b)

Below is the suggested script for Clip (b) ? a short (30-60 seconds) clip in which a local farmer who has implemented SRI mentions that she has successfully implemented SRI.

Video producers should feel free to revise language, tone, and details of the content. The goal is a short, testimonial clip in which someone who was initially uncertain of their SRI-planting ability is now confident of their ability and encourages others to try it.

Recommended actor type: Same actor as in current videos ? a woman who has successfully tried SRI in the past.

Dress: Actor is dressed in normal clothes worn for farming activities.

Background: Actor is standing in front of their well-stocked store of rice, or in front of a neutral background (such as a house, or a farm, or a forest). They look directly into the camera when speaking.

Script: “Our household has been using SRI for paddy for several years. At first, I was not sure if we could plant SRI, because the technique is different from traditional method. So, we tried it in a corner of one of our plots of land to begin with. We found that planting using SRI is not that different from traditional method. We also found that the VRPs are very helpful in keeping us informed. We asked them questions from time to time and their answers helped us. Every year, we have had a larger harvest with SRI than we did with traditional method. And now we know that we are able to plant using SRI. My family is a regular farming family– if our household can plant with SRI, then your household can also plant with SRI, too.”

Instructions to VRPs: After this section of the video plays, the VRPs should pause the video and do the following: First, ask the audience to repeat the last sentence of this section out loud and in unison, as follows: “If that woman?s family can plant with SRI, then my household can plant with SRI, too.” Second, ask if anyone in the audience has implemented SRI successfully. If there is such a person, that person should be invited to share their experience with the group. After that, again ask everyone to recite in unison, “If her family can plant with SRI, then my household can plant with SRI, too.”