Improving Smallholder Agriculture via Video-Based Group Extension *

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

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Abstract

We examine the effectiveness of video aids in training low-caste female farmers in rural India in adopting a climate-smart agronomic technique known as System of Rice Intensification (SRI). Our results indicate that adoption, output and profits increase above and beyond the outcomes of farmers trained only with traditional group extension without video aids. Holding content constant, the additional medium of facilitated video increased yields by 20-30%. Households increase their sale of rice, but the majority is stored and consumed. The latter provides treated households with a favorable income effect, and households reduce their off-farm labor by a similar magnitude in the subsequent season. In the second year, we find the treatment groups' outputs remains as high as in year one, and the control group becomes as productive treated. This suggests that learning may transpire more quickly with the video aids than with standard extension alone.

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†Facebook

‡Northwestern University, Jameel Poverty Action Lab South Asia

§University of Michigan, School of Information

¶Cal Poly, Department of Economics and Columbia University, Intl Res Inst Climate & Society

1 Introduction

Low income countries produce 70% of the world's food (Palacios-Lopez et al., 2017), and yet a small fraction (5%) of farmers receive training in practices that can make them more productive, resilient, or cost effective (FAO, 2011; Priyanka and Majumder, 2017). One of the major obstacles to effective training is that traditional extension training, where an extension agent trains a farmer or a group of farmers face-to-face, is limited in its ability to scale, particularly in remote areas (Anderson and Feder, 2007). More recent approaches that use local social networks to disseminate information (BenYishay and Mobarak, 2018; Kondylis and Zhu, 2017) are effective in their reach and at increasing adoption, but face the cost of mapping local social networks and identifying central farmers whose job it is to train others. Information and communication technologies (ICTs) are increasingly being used to scale information dissemination in a low-cost manner, predominantly using Short Message Service (SMS) (Aker, 2011; Fabregas et al., 2019; Fafchamps and Minten, 2012; Nakasone et al., 2013). But the latter studies have largely focused on increased access to price and weather information, delivered via short and factual SMS messages (Aker, 2011; Nakasone et al., 2014). This is hardly suited to agricultural training, which requires greater personalization than what a text message permits (Baumüller, 2018; Cole and Fernando, 2012; Fu and Akter, 2016). Thus, low-tech tools may be more personal but have limited reach, while higher-tech tools have reach but can convey less nuanced information.

Effective training requires that both the structure of the training – medium, frequency, content – as well as the quality of the training – accessibility, personalization, credibility – are equally able to scale. One such medium is video. With video, content can easily be shown and re-shown, the quality can be credibly maintained, the information can be tailored, and the delivery can be performed by individuals who similar to their viewers.

This paper presents evidence from a randomized controlled trial testing the impacts of video extension, offered in addition to an existing traditional extension training program provided by India's National Rural Livelihoods Mission Program (NRLM). We vary the medium of extension delivery, video versus traditional training, holding content constant, as both approaches are teaching the same technique, System Rice Intensification (SRI), to female farmers in rural Bihar. First, the video training is far more scalable than traditional training and visit (T&V) extension services, in which officers interact with farmers one-on-one and typically reach only a small fraction of an upper echelon of farmers (Feder et al., 2006). Second, video training can maintain a consistent quality of a program - in terms of its accessibility, personalization, and credibility, which we discuss later.

To test this, we collaborated with a non-governmental organization, Digital Green, whose distinguishing feature is its employment of tailored video instruction in group settings that primarily targets hard-to-reach female farmers. We targeted 2,520 households, a third of whom were randomly assigned to traditional training, and the other two-thirds to video training, in addition to traditional training.[1] Farmers assigned to video training, were also

[1] We do not have a treatment arm with only traditional training as NRLM extension training was already active in all the rice-growing districts of Bihar. For an evaluation of NRLM alone see Kochar et al. (2020).

randomly assigned to one of three sub-treatments: DG only, DG with additional informational labor messages; DG with additional self-efficacy based messages; and DG with both messages; in order to isolate more precisely what the barriers are to the adoption of SRI.

We find the video-based training increases adoption of SRI from 10.6% to 15.2% (p-value of difference = 0.06). Reported output increases on average, in a range of 117-261 kilograms per farm (313-526 kilograms per acre), a 20-45% (28-47% per acre) increase over the mean output of 586 kilograms (1123 per acre) in the control group. We can see that with the increased output farmers consume and store the majority of output (70-80% of total output), and sell the remainder. In the first year of the intervention the amount sold increased three fold. Households also reduced their off-farm labor, their primary source of cash income, in the subsequent rabi (winter) season, reflecting a potential income effect from the intervention. The effects of the additional sub-treatments are minimal. We find some positive effects on overall profits for the treatment with both labor and self-efficacy messages, but otherwise do not capture any added benefits from the targeted messaging. We also observe that the benefits gained by the treated DG group are retained in the second year, but that control group catches up in their output by year two. This effectively demonstrates that DG expedites the learning process, as the content presented by the DG videos versus NLRM are essentially the same, but only the medium of instruction changes. Overall, we find that with increased output and profits, the main DG treatment arm of group-based video training does prove to be a cost-effective means for training and disseminating information.

In non-agricultural contexts, video-based learning has proven to be effective in a number of settings, for example in: affecting life-changing behaviors such as intake of fortified salt (Banerjee et al., 2015); safer sexual behavior (Banerjee and La Ferrara, 2016); engagement in entrepreneurial activities (Bjorvatny et al., 2019); increased financial literacy (Berg and Zia, 2017; Coville et al., 2014); reduction of teen pregnancy (Kearney and Levine, 2019); more active political participation (Mvukiyehe, 2018); and improvements in conflict resolution (Levy and Green, 2019).[2] Video also has the advantage of being low cost, while still being able to target its content to the skill level of the student (Muralidharan et al., 2019) and the teacher (Jackson and Makarin, 2018). Given the success of video based learning in other domains, it is not surprising that there is push for video-based training in agriculture (Fabregas et al., 2019).

That said, even with useful content, and effective mediums of delivery, there is still no guarantee that farmers will incorporate new knowledge into their daily practices. Ravallion et al. (2015) studies the effects of video based training on an employment program established under the National Livelihood Rural Mission (NLRM) program. Participants show a significant improvement in their knowledge of the program, but no change in their employment outcomes. Recent findings from psychology and behavioral economics suggest that a host of factors impinge on whether new information is applied productively (DellaVigna, 2009). The framing and context of information can have disparate outcomes on behavior (Tversky and Kahneman, 1981). In particular, the timing on when information is delivered can be a deciding factor in whether the technology or practice is adopted. Farmers are more likely

[2] See DellaVigna and La Ferrara 2015 for a review.

to purchase inputs when they are cash rich, at the time of harvest (Duflo et al., 2011). Committing to a new task can also be challenging. Reminders or commitment mechanisms to perform a task can increase action, even when no new knowledge is delivered (Ashraf et al., 2016; Karlan et al., 2016; Thaler and Benartzi, 2004). The credibility of whether a new technique will actually work is also crucial. Several studies show that learning from peers positively influences adoption (BenYishay and Mobarak, 2018; Kondylis and Zhu, 2017; Vasilaky and Lenoard, 2018). To this end, an individual's self-efficacy with respect to a task can also affect the likelihood of action (Bandura, 2000; Bandura et al., 1996), as can their emotions (Campos-Vazquez and Cuilty, 2014).

These findings demonstrate that effectively portraying the potential benefits of applying new knowledge also depends on the persuasiveness of that content. Thus far, the video examples cited above offer two hypotheses for what is required of persuasive information beyond scalable dissemination. In the work by Jackson and Makarin (2018) and Muralidharan et al. (2019), persuasion may be accomplished by having video-based dissemination embedded in an instructional context with live teachers. In Bjorvatny et al. (2019), Banerjee et al. (2015), and Banerjee and La Ferrara (2016), show that information that is constructed to be entertaining – as "edutainment" – has persuasive power. Perhaps for this reason, edutainment projects are on the rise in international development (WB1, 2015).

DG's methodology incorporates many of the latter ideas, of live teachers with entertaining elements, and one additional crucial feature that speaks to the importance of the peer learning literature. DG videos feature actors who have similar backgrounds to their audience members, come from the same districts as DG participants, and have voluntarily adopted new farming techniques. Their lived experiences, and farming experience are familiar and relatable for participants, and their narratives are conveyed in their common local language. Bernard et al. (2015) demonstrates that this approach, of incorporating actors who are both demographically and geographically close to their viewers, is effective in changing behavior. It also recognizes that farmers learn-by-doing and learn-from-others (Conley and Udry, 2010). The DG methodology, in essence, expedites the process of learning-from-others; rather than taking a full growing season to observe the outcome from other farmers' adoption, DG condenses that experience into short how-to videos.

The videos also have clear advantages over text-based methodologies when working with participants with limited literacy (Donner et al., 2008). Information is disseminated in a "bottom-up" way and in a group context that encourages discussion, similar to Farmer Field Schools, which are typically seen as more effective than the "top-down" approach of T&V programs, but often prohibitively expensive (Anderson and Feder, 2007). A Village Resource Person (VRP) plays the videos (three in total across the season) curated by Digital Green with its assigned group of farmers. The viewing process is participatory in nature, with a question and answer period following each video showing. Farmer groups can request to see any given video more than once. The methodology also applies ideas whose value is only hinted at by the literature reviewed above, but not fully confirmed. For example, DG video viewing is embedded within a practice of self-help group meetings, in the same way that Jackson and Makarin (2018) and Muralidharan et al. (2019) embed video-based interventions within teacher-run instructional contexts. And, DG videos contain edutainment features, in the vein of Bjorvatny et al. (2019), Banerjee et al. (2015), and Banerjee and La Ferrara (2016). Many of these how-to videos have a narrative arc with character and plot. Our field experiment provides additional evidence that these practices – embedding within manned instructional contexts and edutainment – are fruitful for development interventions.

In addition to testing the medium of video-aided extension training in conveying the benefits of adoption, we sought to nest additional messages that would directly address some of the risks of adoption. According to Digital Green's own experience, two of the most frequently reported barriers to SRI adoption among its farmers are (1) SRI's high labor demand and (2) lack of farmer self-efficacy. Thus, in the first nested treatment, we add video content that explains that on average, SRI requires an additional person-day of labor per katha, and results in a marginal gain of 500 INR per katha. The viewer is, therefore, given additional information about SRI's cost-effectiveness. In the second nested treatment, we attempt to address self-efficacy – whether a farmer believes she can implement the technique. Self-efficacy is among the most studied constructs in modern psychology. Among its key findings is that a person's confidence with respect to a task affects his or her motivation to perform it, and that one way that self-efficacy works is vicariously, through role models with whom one identifies (Bandura, 2000; Bandura et al., 1996). Self-efficacy has been found to affect women more than men (Beyer, 1990), and to influence decisions affected by external risks (Cox et al., 2007; Crosby et al., 2001). Our corresponding intervention adds video content that highlights that the actors in the videos are local farmers, just like the viewers, and that if the actors can take-up the practice, the viewer should be able to as well.

Concurrent studies by Abate et al. (2018), Lecoutere et al. (2019) and Van Campenhout et al. (2018) also investigates the impact of DG's methodology in Ethiopia and Uganda. Abate et al. (2018) focuses on the adoption of three different practices: row planting, lower seeding rate, and fertilizer top dressing in the context of teff, wheat, and maize. Aside from also evaluating the overall effectiveness of DG's methodology relative to conventional training, the study tests whether including female farmers' husbands in the intervention improves females' adoption rates. Overall, they find that Digital Green improves adoption beyond traditional T&V visits (ranging in increases of 3 to 10 percentage points above the control group - a similar magnitude found in this study). Spousal presence, however, did not affect adoption rates. Van Campenhout et al. (2018) and Lecoutere et al. (2019) tests the overall effectiveness of video-based learning via Digital Green on maize production outside the context of any existing extension training program. Van Campenhout et al. (2018) tests the added benefit of interactive voice messages (IVR) or short messages services (SMS) that remind farmers about agronomic practices. They find that video training alone has statistically significant impact on the adoption of several new maize practices and increases yields by 10%, but IVR and SMS have no added impact. Lecoutere et al. (2019) focuses on the impact of the recipient's gender in video based training - that is, who receives the information: husband, wife or both - on knowledge, adoption, and yields. There is a statistically significant increase in women's knowledge index when women receive information alone or in pairs, while men's knowledge index exhibits a statistically significant decrease when women are present. Womens' production and productivity also exhibit a statistically significant increases on their own plots (and no effect on jointly managed plots) when trained alone (35.8 kg and 50.4 kg/acre respectively) or in pairs (51.5 kg and 75.1 kg/acre respectively).

While complementary to our results, our study has several distinguishing features. First, in comparison to Van Campenhout et al. (2018) and Lecoutere et al. (2019) our RCT measures the additive impact of video-based extension in the presence of an existing government based extension program. This is a pertinent question, as governments often have existing extension programs in place, which they may want to retain rather than dismantle or have overridden, but whose impacts are limited for the reasons cited above. Understanding whether DG can work with, and provide additional benefits to, existing institutions, is relevant to other developing countries that rely on agriculture. In comparison to Abate et al. (2018) we both find similar increases in adoption, but ours also finds increases in output and yields. We study how this impact's households' decision making on other outcomes, including their participation in off-farm labor, and their decision to store versus sell their output. Lastly, we test whether persuasive messages targeting specific barriers provide any additional gains.

This paper is organized as follows. Section 2 provides background on the research context. Section 3 describes the data and study design in the RCT framework. Section 4 examines the effects of the treatment arms on inputs and outputs. Section 5 discusses policy implications. Section 6 concludes.

2 The Setting: Bihar, Digital Green and System of Rice Intensification

We undertook our study in Bihar, India, across three districts: Nalanda, Muzzafapur, and Purnia. Bihar is one of the poorest states in India, with a per capita GDP of 28,317 INR (440 USD) per year, or about 1.20 USD per day, and low literacy rates: 69% for males and 49% for females.[3] Even during the economic prosperity from the Green Revolution, Bihar experienced some of the lowest poverty reduction (Ravallion and Datt, 2002). Agriculture remains the primary livelihood of individuals in Bihar, and is key to improving individual well being and general food security. Rainfed rice and wheat are the primary crops, with minimal modern irrigation or canal water.

Agricultural extension training in India is largely governed by the state Department of Agriculture (DoA). Among the relevant bodies are the Indian Council for Agricultural Research (ICAR), which provides training information to DoA; the state agricultural universities (SAU), which works with ICAR on relevant research topics; the Agriculture Technology Information Centres (ATICs) and Krishi Vigyan Kendras (KVKs, or Farm Science Centers), where ICAR conducts its research; and the Agricultural Technology Management Agency (ATMA), a central government initiative that supports decentralized state extension programs.[4] By and large, most of the approaches provided by any of these institutions follow

[3] https://data.worldbank.org/

[4] For an in-depth overview of agricultural extension in India see Glendenning et al. (2010).

a T&V structure, which are top-down, face-to-face, and insufficiently resourced to meet demand. As of 2017, the ratio of public extension workers to families was 1162:1.[5] Scalability and effectiveness of agriculture extension are therefore of paramount concern in India.

2.1 Digital Green & NRLM

DG originated to address both the scale and effectiveness of agricultural extension training in India. It began as a Microsoft research project whose early promise in India led to spinning off the effort in 2008 as a non-profit. DG focuses its efforts on amplifying the impact of smallholder extension programs (Gandhi et al., 2009). It accomplishes this by overseeing the production of short how-to videos featuring local farmers executing productive agricultural practices. The videos are then used as the basis for mediated group instruction. DG partners with, and trains, other organizations that disseminate the techniques, and its method is also now used for other types of behavior change campaigns, including health and nutrition. The video content is generated using an iterative approach with the agricultural organizations and farmers for whom they are developed. A few key aspects of DG's early qualitative field work found that viewers prefer to see and hear information coming from individuals similar to themselves as opposed to trainers or government officials; they prefer seeing multiple people and multiple locations throughout the video; and they prefer mediation with pauses and interaction (Gandhi et al., 2009). A small-scale cost-effectiveness study also suggested that Digital Green was 10 times more cost-effective than T&V in persuading farmers to adopt a new practice. As of 2018, Digital Green videos have been viewed by over 1.5 million farmers in India, Ethiopia, and a handful of other countries.

In 2011, India's Ministry of Rural Development launched the National Rural Livelihood Mission (NRLM), a program supported by the World Bank. In Bihar, NRLM established a semi-autonomous body called Jeevika, which was state-funded and organized as a non-profit NGO. Its aim was to establish a network of self-help groups (SHGs) in which at least one woman from every poor rural household was a member of a small group of 10-20 individuals that met regularly. Jeevika would then involve the SHGs in microcredit programs, health and nutrition education, and agricultural extension.[6] Following a common practice among Indian NGOs, Jeevika implemented agricultural extension within the SHG structure, with extension officers providing agricultural advice at SHG group meetings, as opposed to the one-on-one visits that are common with T&V. DG's methodology of group video-viewing fits well with SHG mobilization. Jeevika committed to incorporating the methodology across Bihar with staggered phase-in, so as to permit a RCT. In the control and treatment villages, Jeevika implemented in-person extension via SHGs and locally hired facilitators. In treatment villages, Jeevika, with advice from DG, ran video-viewing sessions led by facilitators.

[5] http://icrier.org/pdf/Agriculture-Extension-System-in-India-2018.pdf

[6] Ministry of Rural Development - Letter on SHGs to the Government of India.

2.2 System of Rice Intensification

Rice, or paddy, as it is sometimes known, is a water-intensive crop that is grown widely in both flood- and draught-prone Bihar. Conventional rice cultivation consists of continuous flooding of fields with groundwater. However, India is rapidly depleting its scarce groundwater resources in semi-arid areas of India, as much as a foot per year (Fishman et al., 2015; Rodell et al., 2009; Russo et al., 2015). Roy et al. (2016) show that between 1901 and 2002 rainfall has declined by 1.974 mm per year and mean temperature has increased by 0.479 degrees Celsius per year in Bihar. The Ministry of Water Resources has reported levels of arsenic (above 10 ppb) and fluoride (more than 1.5 mg/l) beyond the permissible limits in Bihar, a direct consequence of groundwater depletion.[7] In addition, Bihar is one of the worst ranked states in India in terms of water conservation (a water index below 50%) according to the Composite Water Management Index (CWMI) developed by the government's National Institution for Transforming India.[8] Yet, Bihar is a major contributor to agricultural output, and, therefore, to India's food insecurity. This set of circumstances – increasing groundwater depletion and food insecurity – is not unique to Bihar. All across India and other parts of the world, a changing climate will stress agriculture with more extreme storms and more intense periods of agricultural drought, and more erratic weather patterns (Adams et al., 1999; Collins et al., 2013; Dell et al., 2012; Dinar et al., 1998). Without additional training, only farmers, who have the means to deepen their well and purchase stronger pumps, will be able to continue to cultivate lucrative crops, such as rice, that require intensive watering.

For this reason, with input from Jeevika, we chose to focus on the introduction of the System of Rice Intensification (SRI) practice, a climate-smart technique for cultivating rice that reduces resource use while also increasing yields. SRI reduces the need for water, seeds, fertilizers and pesticides, while increasing yields in ranges of 32-48% (Sinha and Talati, 2007; Thakur et al., 2010). The key component to SRI's success is the transplantation of young seedlings at an earlier stage than conventional practices suggest, with wider spacing between seedlings. This allows seedlings' roots to grow larger and deeper into the soil that is kept well aerated. There are several additional steps to SRI that contribute to higher yields, including: seed treatment,[9] nursery bed cultivation,[10] later transplantation,[11] and the use of a cono weeder.[12] Among these steps, transplantation tends to be the most impactful.

[7] India Environmental 2015 Report, pg 14.

[8] National Institution for Transforming India Water Index Report, pg 17.

[9] Seed treatment includes soaking in brine solution, rinsing 3-4 times with fresh water, soaking in water for 18 hours, treating with Bevastin powder, and storing in a roped sack for 24 hours in shade and sprayed with water twice daily.

[10] If the field is ploughed four times, then remove grass and weeds. For an 1 acre field, 6 beds of paddy seeds should be planted with each bed being 30 ft in length, 5 ft of width, and 6 inches in height. Drains should be prepared that are1.5 ft wide and 6 inches 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 vermi compost followed by a spreading of straw.

[11] SRI requires 4-5 ploughings before preparing the land. Seeds are removed with the soil from the nursery bed. Seedlings from the nursery are transplanted with mud on their 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 than 30 minutes.

[12] Before weeding, farmers irrigate the paddy field a day before so that an inch of water remains. The cono

Several field studies have demonstrated SRI's reduction of water use and increase in yields, not only on experimental plots, but also in farmer field trials. However, there are tradeoffs that farmers must consider before adoptiong SRI. In particular, farmers anticipate an increased cost of labor despite the potential increase in returns. SRI can significantly reduce water use while increasing yields; however, its profitability hinges on output prices being no lower than the price that traditionally grown rice is sold (Alem et al., 2015), and on labor costs not being prohibitively expensive (Takahashi, 2013). In our context, market prices for rice in India are relatively stable as the government of India fixes the central procurement price of rice before planting begins (Aditya et al., 2017). This reduces some of the uncertainty in projecting potential returns. Thus, in this study, we are able to focus on the remaining factors that we identified as impeding adoption.

3 Data and Design

We ran a randomized controlled trial (RCT) to determine the causal impact of DG by randomly assigning which villages would be offered the DG viewings of a relatively new agricultural technique, System Rice Intensification(SRI).[13] At the start of the intervention about a third of households in the baseline had heard of SRI, and 10% had reported that they had implemented some form of SRI, but we did not confirm what had actually been implemented. (These figures are based on our baseline data, which was compromised and we discuss below.)

We conducted a clustered randomized controlled trial, where we targeted 420 villages randomly assigned to one of 3 treatments or control: 140 control villages that would receive only non-DG NRLM training; 70 treatment villages that would receive basic DG-based training; 70 villages that would receive basic DG plus labor cost messages; 70 villages that would receive basic DG plus self-efficacy messages; and 70 villages that would receive basic DG plus labor cost and self-efficacy messages. Within each village we attempted to survey approximately 6 women who were randomly sampled from the village's SHG. These villages were randomly selected from a list of 607 villages in three districts in the state of Bihar: Nalanda, Purnia and Muzzafapur. The districts were selected as areas where NRLM was present, but DG had not yet been introduced nor had SRI training been conducted prior to the start of the intervention. Farmers could still have heard of (33%) of SRI, but only a handful said that they implemented some form of SRI in the previous seasons prior to the start of our intervention.[14] All villages - in treatment and control - received NRLM training that incorporated SRI messaging. Thus, there were no differences in the agricultural information provided across control and treatment villages. The household survey collected information on SRI adoption, household demographics, plot and paddy cultivation details, land ownership, familiarity with SRI, perceptions on costs of SRI, paddy practices, water

weeder should be used twice within 15 days of transplantation. The space between rows of paddy should be 10 inches when applying the cono weeder.

[13]RCT registered at Social Registry 313.

[14]This met the requirements of our power calculations to detect a 10% increase in outcomes: sampsi 0 .1, sd(1) r1(.8) pre(1) post(1) p(.8) ratio(3).

sufficiency, access to agricultural extension, expenditures, self-efficacy and aspirations.

Figure 2 depicts the experimental design and timelines, including the number of villages and households that we were able to reach and that were eligible (namely households that were willing to participate and that grew rice). We collected four rounds of data.[15] The first round began in May 2014 before the mandated transplantation date of June 15th in India. This baseline was met with considerable delay due to the general elections in India and floods in Bihar that year. Baseline data collection was limited to only 719 out of the desired 2520 respondents, as shown in the first row of Figure 2. For this reason, we analyze each panel separately, given our limited pre-intervention baseline data, where attrition was likely non-random. The second round, was a midline survey that took place during August - August 2014, and reached all of the originally selected villages. This first midline surveyed individuals on their adoption practices during the 2014 kharif (summer) season, as well as inputs used during the planting season. We conducted two endline surveys to capture initial adoption and long-term adoption. The first endline, took place in the spring (Feb - March) 2015, and the second endline, took place during the Spring (Feb - March) 2016. The endlines surveyed individuals on their harvests at the end of the season, inputs used during harvest, off-farm labor performed after the season ended, and their perceptions regarding the SRI practice.

3.1 Program and Intervention

The intervention took place between June and August 2014, and June and August 2015, during the months of cultivation and harvest. In the control villages, Jeevika ran its SHG-based non-video extension program. This program covered the four SRI topics of seed treatment, nursery bed preparation, transplantation, and conoweeder use.[16] Jeevika covered all four of these components of SRI verbally in one session sometime between May and June and then conducted four separate field demonstrations for each topic in the ensuing weeks. A VRP was assigned approximately 10-12 SHGs per a village. For the control, VRPs used charts and posters during meetings, and utilized physical inputs (land, seeds, fertilizers) to conduct field demonstrations.

In the treatment villages, Jeevika, with assistance from DG, prepared videos for the same SRI topics: seed treatment, nursery bed preparation, transplantation, and conoweeders.[17] The videos were prepared based on standard DG protocol of featuring a local farmer who demonstrates the technique. Table B.1 describes the content and protagonists of the videos. The main treatment arm of DG alone is depicted by a female farmer, and the three additional sub-treatments: labor, self-efficacy, and labor + self-efficacy are depicted by male farmers. In each treatment village, Jeevika held its standard verbal session overviewing all four techniques in the treatment villages, and then VRPs held viewing sessions for each of the

[15] The data were collected by the Jameel Poverty Action Lab South Asia. Survey instruments can be found at Social Registry 313.

[16] A conoweeder is a handheld mechanical device that uproots weeds that grow between planted rows.

[17] Examples of Digital Green's videos can be found here.

topics in the following weeks. Videos were shown in a common meeting place in the village where they could be projected on a wall. Each video was shown at least one time, but SHGs were free to request a second viewing during the time that the video was first shown or at a later meeting. SHGs had a total of three DG meetings.[18] VRPs were instructed to pause the videos and read any text that appeared on the screen, after which they would conduct a question and answer session. The treatment arms contained no difference in information delivery, material transfers, or approximate frequency of SHG meetings compared with the control.

In the nested treatments, in addition to the core information about SRI, the DG videos also provided information on two additional issues that the research team determined as information gaps with regards to SRI adoption: uncertainty regarding labor costs, and farmer uncertainty in being able to perform the SRI tasks. One of the major deterrents to adopting SRI is the potential need for extra labor, given SRI's more involved pre-planting and planting stages. As a result, in some cases SRI results in a reallocation of labor from off-farm to farm labor, or the need for hired labor (Berkhout et al., 2015; Takahashi, 2013), but in other cases SRI does not appear to require more labor but does require additional attention to all of the particular tasks involved (Ches and Yamaji, 2015). In the SRI method prepared and presented by DG's videos, SRI implementation required an additional day of labor per katha at each stage for a average total of 4 more days than conventional rice cultivation. The video clips exposit the potential returns to SRI, and thus it is up to each farmer to determine if those returns would be profitable for them based on their labor availability or cost of hiring labor. On average, an additional day of male labor costs in a range of 160 to 180 Rs. for our population. Thus, if SRI yields 50 kg more of rice per katha, and the government price for rice per kg is approximately 10 Rs., then SRI can return 300 Rs. more per katha on average.

Apart from the economic constraints to adoption there are also psychological aspects to behavior change. Very often development schemes focus on alleviating external constraints - income, credit, risk, time inconsistencies, etc., but perceptions of one's own abilities can affect take-up even if the economics are in one's favor. Farmers' outcomes depend on their own abilities to implement a new technique and the belief ex-ante that they can successfully complete it. One way in which farmers develop this belief is by watching successful peers. The peer-effects' literature is rich with examples of how farmers learn from those who are similar to them (Bandiera and Rasul, 2006; Bursztyn et al., 2014; Conley and Udry, 2010). Peer-learning can be a slow process, especially if a crop is new and there are few early adopters like. Potential means to expedite this learning process is by pairing peer farmers or by incorporating them into the extension training process (BenYishay and Mobarak, 2018; Kondylis and Zhu, 2017; Vasilaky and Lenoard, 2018). This approach, however, requires at least one season to realize an experience, and that at least one farmer adopts the practice without prior experience during that season.

Thus, without sufficient examples of successful attempts by farmers like themselves one's own self-efficacy becomes all the more important. Bandura (1977) is a seminal work that outlines

[18] The conoweeder video was ultimately not used in the treatment arms due to DG staff concerns that SHG members did not own conoweeders.

why personal self-efficacy matters for human agency. This work highlights how beliefs in one's own abilities to produce certain outcomes and circumvent others is essential for taking action. Few studies have investigated the role of self-efficacy in agriculture. Wuepper and Lybbert (2017) recognizes the need to address self-efficacy in development studies, and they provide a broad overview of studies working on self-efficacy. Wuepper et al. (2016) is one study that is most relevant to this work. Using an instrumental variables approach, it shows that farmers in Ghana with increased self-efficacy are better able to respond to periods of insufficient rainfall, and also more likely to adopt a climate-smart technology. That said, we are unaware of studies using an experimental field approach to understand the impacts of self-efficacy as we do here.

4 Program Effects

In Table 6 we present a balance table, comparing observable inputs and outputs of the paddy production process between treatment and control groups for the baseline. As mentioned earlier, the baseline suffered from attrition, and, as a result, is a smaller sample than the targeted sample. We first test whether the observable covariates for the baseline sample are statistically similar across treatment groups. The last column presents the p-value from an F-test testing the equality of means across assignment. Overall, we can see that treatment and control is largely balanced along the outcomes we will be studying, namely the inputs used in the cultivation of rice, and farmers' output. There is some imbalance in terms of hired labor in the baseline, which is driven by the third treatment arm, which received the Digital Green training with a self-efficacy message. In Appendix A Table A.1 we present summary statistics for the full sample, but after the intervention had already begun. Thus, the characteristics we summarize here are those that were not likely to have changed as a result of the intervention, for example, demographics, home characteristics, and ownership of major machinery. We see no imbalances along these dimensions.

We estimate the following specification to capture intent-to-treat effects - the average causal effect of being offered DG training- of the main treatment and sub-treatment arms. The omitted group is always the control group, which received non-DG NRLM training in the same SRI practice. Y is the outcome variable, T_i is treatment i, where the the omitted category is the control group that receives NRLM training, T_1 receives DG, T_2 receives DG with the labor messages, T_3 receives DG with the self-efficacy messages, and T_4 receives DG with both messages. ϵ is assumed to be normal, and we cluster our standard errors at the village level, correcting for any correlation between neighbors within a village.

$$Y = \alpha + \beta_1 T_1 + \beta_2 T_2 + \beta_3 T_3 + \epsilon$$

4.1 Impacts on Adoption

We begin with summarizing self-reported adoption. The DG treatment had an economically and statistically significant impact on the number of adopters. Table 3 Panel A reports the estimated intent to treat (ITT) on adoption in Column 1. The dependent variable in Table 3 is a dummy variable taking the value 1 if the respondent says that she adopted SRI and 0 otherwise. The regression coefficient for the overall ITT is the difference between self-reported adoption of SRI under DG versus the control. The video-based training had a statistically significant impact on self-reported adoption with a large increase over the control group's adoption.

DG increased adoption by 4.6 percentage, where the baseline adoption rate of SRI for the control group is 10.6 percent. DG, therefore, increased rates of adoption by 44 percent. In Panel B, Column 1, we break down the DG treatment by its mutually exclusive subtreatments. We can see that here the DG impact is driven by the second treatment arm, DG with labor messages. Farmers who received the DG and labor message increased adoption by 6.6 percent, a nearly 62 percent increase over the baseline. That said, the other treatment arms with self-efficacy alone, or self-efficacy with labor messages, are not statistically significant and the effects are more imprecisely estimated. 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. Female farmers were more reluctant to answer questions regarding their beliefs in their own ability than their beliefs of more exogenous factors such as labor.

Post-hoc discussions with DG suggest, that adoption rates based on a binary response underestimate actual adoption rates. In addition to the binary adoption question, we also asked specific questions about the adoption of SRI practices. It is feasible that participants reported overall non-adoption, even as they implemented some of the SRI techniques, and then, too, only in a single plot, and so on. Indeed, prior studies such as Ly et al. (2012), show that farmers are likely to adopt only a portion of SRI practices, and that these practices are then often applied to conventional rice farming practices, which they call "SRI-influenced practices." Such a partial adoption can still be impactful, and less risky to the farmer than complete adoption. To consider this, in Table 3 Column 2 we estimate a Tobit model of an adoption index built from responses to adoption of the individual practices. The index ranges from 0 to 4, where each reported adoption stage represents one of the critical stages towards adoption: seed treatment, bag treatment, nursery preparation and transplantation. For example, if two of these stages are adopted, then the index value is one half. A Tobit model assumes an underlying latent process in the outcome variable that we cannot observe. For example, a farmer's decision to adopt at least one SRI practice may include other decisions, cognitive or physical, that are not observable to the researcher. Panel A shows that being assigned to any DG treatment increases the likelihood of adopting an additional SRI practice by 23%. Panel B shows that that it is the DG and labor messages treatment arm that is driving the effect, with a 33% increase in adopting an additional SRI method.

Our main results indicate that DG has a statistically significant impact on farmers' adoption of SRI that augments their adoption practices beyond standard NRLM training. The adoption measures are likely an underestimate of partial adoption of SRI. The DG treatment arm with labor messages appears to be driving most of our results. But did the adoption translate into increased agricultural output?

4.2 Impacts on inputs and output

We first investigate the impacts of the intervention on farmer output. To verify the quality of self-reported data we cross-checked farmers' responses for an aggregate measure of rice output against responses to the amount of rice sold, stored, consumed and shared for each household. Responses where the two figures aligned within 100 kilograms of output are referred to as as "Validated" in Figure 2, and what we analyze here.[19]

In Table 3, Panel A and B, Column 6 measures the impact of the intervention on overall output of self-reported paddy. DG increased output by 117 kgs per farm (313 kgs per acre) over the control, and this is driven by the main DG treatment arm, which increased output by 261 kgs per farm (526 kgs per acre). The other DG treatment arms are not statistically significant, which we discuss further below.

In Table 3, we estimate the impacts of the treatments on total inputs used across the first season for all treatment arms (Panel A) and for each treatment arm (Panel B). Note that increased use of inputs is *not* an essential step in SRI, except for a possible increase in labor days as the transplantation process in SRI is more time intensive than it is for traditionally planted rice. The major gains from SRI come from proper spacing of plants during the transplantation stage, and later transplantation of seedlings. Column 3 reflects total family labor days. Column 4 reflects the cost of hired labor in RPS. Column 5 reflects total expenditures on inputs including seed, animal use, pumping water, fertilizer, and machinery use. Table A.3 in Appendix A includes a further breakdown of the changes in each of the inputs for the Baseline the first Endline and the second Endline. Overall, we can see that the DG treatment, for all expenditures combined, did not have a statistically significant different effect on input use between treatment and control overall. That said, input use did increase in both control and treatment compared to the baseline, which is not surprising, as all arms are learning to implement SRI.

4.3 Impacts on estimated farm profits, income and debt

Thus far we have seen that output increased for farmers in the main DG arm. This increase can be attributed to an increase in the adoption of SRI practices taught via DG, which translated into increases in rice output. Whether these changes translate into added income depends on several factors: how much output is sold, the price at which it is sold, the value of stored and consumed rice, and, finally, the relative increase in costs compared to revenues. Before studying how profits changed, it is important to note that average income per household prior to the DG intervention ranged from 39 to 42 thousand Rps depending on the treatment arm. This is important, because the proceeds from farm labor cannot comprise the bulk of cash income for households in this study. From the previous section we saw that five months of off-farm labor gained the household approximately 10 thousand Rps during the rabi (winter) season in 2014. Although we did not survey farmers on their off-farm labor

[19] One question of concern is whether the intervention itself affected farmers' consistency in reporting yields. We test whether the intervention had a statistically significant effect in explaining reporting inconsistencies for yields and find no evidence of this (pvalue = 0.46).

in the kharif (summer) season (the main paddy growing season), we do know that farmers work off-farm jobs year round. Thus, the bulk of household cash income is likely gained via off-farm labor. Conversely, farm output serves as the main source of food consumption.

To estimate farm profits we need a measure of farm output, including output that is not sold, but is instead consumed, stored, or shared. In Table A.5, we see that in the baseline approximately 19% of rice output is sold, 46% is consumed and 35% is stored. Thus, the majority of rice that farmers are producing is consumed or stored. Furthermore, few farmers have any intention of selling stored rice (3% and 2% in year one and two). Given that households (with an average of seven family members) are consuming approximately 50 Kgs of rice per month each year, it is clear that households consume and store a year's worth of household consumption, and this is not statistically different across treatment and control. What does vary is the amount that is sold, which appears to be anything in excess of the average amount consumed over the course of a year. In Year one we observe a statistically significant increase in the amount of rice sold from 129 Kgs in the baseline for DG only to 298 Kgs in year one for DG only.

Constructing profits depends on how farmer output is valued. Overall we cannot price all of farmers' output based on the farm-gate price, since 70-80% of output is stored on average. Rice is potentially more valuable to the farmer in-hand as a consumption good because there is a considerable markup between the farm-gate and retail price of paddy. Unfortunately, we do not capture the price of purchasing paddy at the store. However, several sources point to this markup, which can be substantial - from 10 Rps upwards. Bhoi et al. (2019) depict a substantial markup for rice. Thus, in constructing profits we value sold paddy at the price farmers self report (median of 12 Rps per Kg), and we value consumed and stored rice at an average the retail price in the non-farm season October - June for both the baseline and year one profits (25.6 Rps/kg and 27.8 Rps/kg respectively based on data from Bhoi et al. (2019).

In year one we find that estimated profits increased significantly, by 6,692 Rps for the main DG arm and by 3,690 Rps for the arm with both messages, where the control was 1,010 Rps. At the same time total debt declined for the DG only arm by 3,842 Rps. Considering that annual income is the order of 40 thousand Rps per year, a six thousand Rps increase is a 16% gain in annual income. Profits were lowest in the labor and self-efficacy arms, which saw slightly larger increases in labor costs and smaller gains to output.

Our estimates of profits include households who planted rice but had 100 percent of their crop destroyed (119 in the baseline, and 358 farmers in year one, 217 in year two), and thus our estimates are a lower bound of what profits could be. Both years of our study were impacted by substantial weather shocks. This is reflected in the drop in mean output and profits for the control group in the baseline and in year one. In the first year, 88% of farmers reported some of amount of damage to their rice output. Twenty percent of farmers reported rain shortages (50% in Muzzafapur), and 36% reported floods (72% in Nalanda, and 27% in Purnea). In the second year, 93% of farmers reported some damages to rice output. Seventy six percent of farmers experienced drought (29% in Nalanda and 50% in Purnea), 38% experience crop disease (10% in Muzzafapur, 67% in Nalanda, and 41%

in Purnea). We can also see the decline in rainfall in both year one (2014) and two (2015) during the most critical month of June in Figure 3, when the first transplantation takes place.

4.4 Off-farm wages and business income

Thus far, we observe that the DG training increases adoption of SRI and rice yields, with little observable change in input use, and gains in output sold. Since farmers' primary cash income source is not rice cultivation, we ask how the additional rice sales impacted their supply of off-farm labor. Many of the respondents' household members take on additional jobs as shopkeepers, drivers, tailors, bike mechanics, or traders on other farms year-round. Since farm productivity increased from the DG intervention then households may respond by either diverting more of their labor hours from off-farm labor to their more productive farm or by working less. Table 5 estimates the impact of the DG treatment on the total number of non-farm labor days and hours, as well as non-farm own business income - that is, income received from side businesses of the farmer, during the non paddy season (November - February), when wheat is cultivated. We can see that the number of non-farm work days in a household decreased by 10 days, and off-farm wages decreased by over four thousand five hundred rupees. Own business income did not decline.

The question then is whether the reduction in off-farm work is due to an income or substitution effect? Are farmers substituting towards farm labor away from off-farm labor in the wheat season, or are they taking more leisure? It is unlikley that the DG training in SRI improved farmers productivity in wheat cultivation, as the SRI practices are highly tailored to paddy cultivation. Unfortunately, we cannot test this as we do not have data from the wheat season. In addition, we will argue in the next Section that farmers' cash income is primarily driven by off-farm wages, while farm labor is primarily for consumption purposes. When farm output is in excess of what the family consumes annually, then some of this output translates into additional cash income, and can be a means for reducing in off-farm labor.

4.5 Impacts on Perceived Responsibility

Thus far, most of the impact from the training has been driven by the DG only treatment or the DG treatment augmented by the labor message. The DG treatment with self-efficacy message had no effect on adoption, output or profits. Part of this may be because households in this arm started off with lower levels of output and expenditures to begin with as seen in Table A.2 Column (4). Another possibility is that the additional messaging somehow weakened the effectiveness of the training. For example, it is possible that hearing about the protagonist's relative success actually reduced participants' confidence.

Nevertheless, it is still possible that other related measures of farmers' well-being improved from the training, even if the self-efficacy message alone had no impact. In an effort to capture changes in farmers' own self-efficacy we ask them who they think is responsible for their success. In Table 6 we report the impact of the intervention on whether a female farmer feels responsible for her own life or whether she thinks her parents, her husband, her relatives, God or luck, are responsible for her life. In year one we can see that DG reduced the extent to which females believe that God or luck is responsible for her life by 5% and 3% for the DG only arm. And in year two, belief in one-self increased 3% for the DG only arm. Overall, the intervention appears to have had some impact on the agency of females, although, not consistently, across all arms.

5 Long-term Benefits of DG

At in individual farmer level, the initial first-year impacts of the intervention are clear. There is an overall increase in the adoption of SRI, a rise in output and profits both per acre and per farm, little change in input use, and an increased sense of self-efficacy. Of course, whether these benefits persist is important for improving the welfare of farmers. Digital Green continued to work with the treatment villages in 2015, as did NLRM, and we were able to capture an additional endline in 2016. The results from the subsequent endline are summarized in each of our tables in Panels C and D. Note that we did not conduct a midline in the second year, and, for this reason, labor days, hired labor and expenditure costs *only* reflect costs captured in the endline during harvest. Choices made for pre-harvest tasks were not captured, and, we, therefore, cannot accurately report profits in year two.

At first glance, we can see the effect sizes between control and treatment groups are no longer economically nor statistically significant on a per farm basis. The effect on yields remain weakly significant per acre (358 kgs/acre in Table 2 Column 6), as does the effect on adoption (3.9% in Table 2). However, the reason for this not because the output of the treated groups regressed to that of the control, but rather, that the control improved to output levels of the treated. Table A.3 and A.4 best depicts this via output in kilograms for each treatment group. Output in year two for the treated groups remain as higher or higher compared to year one, while output for the control had a statistically significant increase of 26%. Recall that the control group was also being trained in SRI during the first year of the intervention, but only through extension services. Our results suggest that DG expedited the learn-by-doing process that in-person extension training aims convey. The gains that treated farmers saw in year one are retained in year two, and farmers in the control eventually catch up.

At the state level, the additional costs to implementing DG's practice are a fraction of the cost of implementing baseline SHG-based extension (our control). VRP training and costs (including field visits) under the control are approximately 1050 INR per VRP, and farmer training is approximately 180 INR per farmer. For 1,000 farmers and 10 VRPs this amounts to 190,500 INR for the control (2,000 - 3,000 USD). VRP training and costs (including field visits) under DG are approximately 670 INR per VRP, video production is 200 INR per video, and video screening is 95 INR per screening. For 1,000 farmers (100 SHGs), 10 VRPs, and three video showings per SHG, this amounts to 35,800 INR (500 - 600 USD). Thus, DG costs 18 percent of the cost of implementing Jeevika's standard training, and causes a significant boost in adoption and output beyond the control.

6 Conclusion

We present experimental evidence on the effects of a video-based intervention that trains female farmers in Bihar, India, in the presence of an already existing traditional extension training infrastructure. The additional video-based training had substantial and significant effects on marginal farmers – female farmers from backward castes – who otherwise do not receive direct training on a repeated basis. We find that the intervention increased adoption and yields by 44% above the control group. In addition, we show that estimated profits increase in the order of 3 - 8 thousand Rps for Any DG and the DG only arm, respectively. Profits are even higher once we control for households that experienced 100% crop loss due to drought or floods in year one. We suggest that DG's methodology is effective because it overcome issues with heterogeneity in extension trainers' instruction quality, is narrated by women similar to the viewers who are watching them, and mediated by a local village representative, increasing interaction and viewers' comprehension.

We find that farmers in the study cultivate rice primarily for consumption and only sell what output they have that in excess of their annual consumption needs. The majority of their cash income is derived from off-farm labor. However, any gains in rice output above their consumption requirements, is sold, which can provide farmers with a favorable income effect. For example, in year one we see that households reduced their off-farm labor during the subsequent rabi season.

We find variable effects of including more subtle messages in the sub-treatment arms. The labor message appears to increase adoption, but not output, and increased labor costs more than in the main DG arm without messaging. The self-efficacy arm did not have any impact on farmers' outcomes, which may be partially due to lower input use in the baseline. However, further research is needed to identify if there are other mechanisms at play, such as information overload, or other behavioral responses to the messages.

The long-run effects of DG in year 2 are of smaller magnitude, and not statistically significant (with the exception of the per acre measures). But this is not because the treated groups' output regressed to that of the control's, but because the control group's output increased to that of the treated. This is likely because video-based training expedites the learn-by-doing process, which otherwise may take a full growing season to take effect under standard extension training.

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Figure 1: Map of Control and Treatment Villages

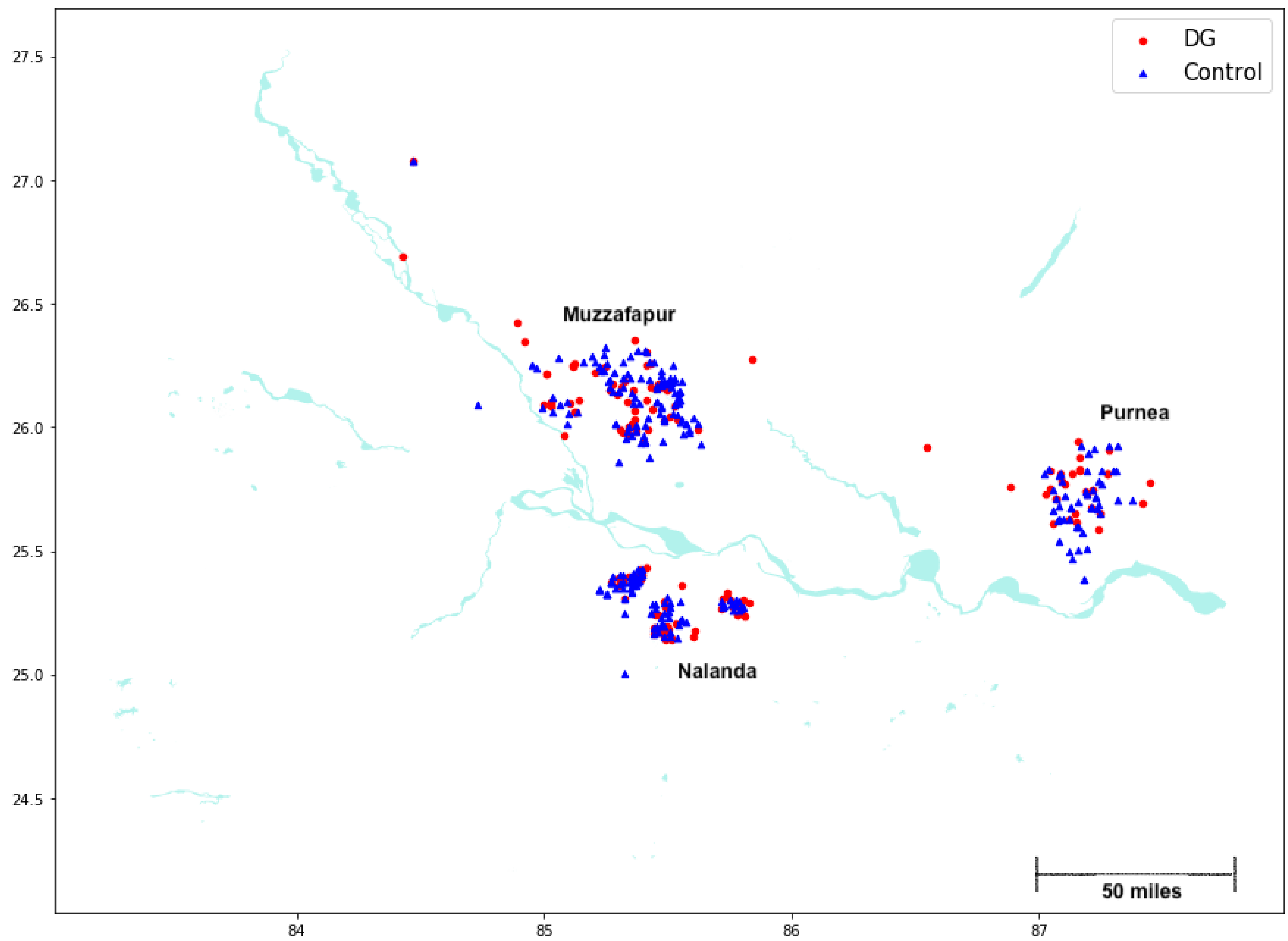
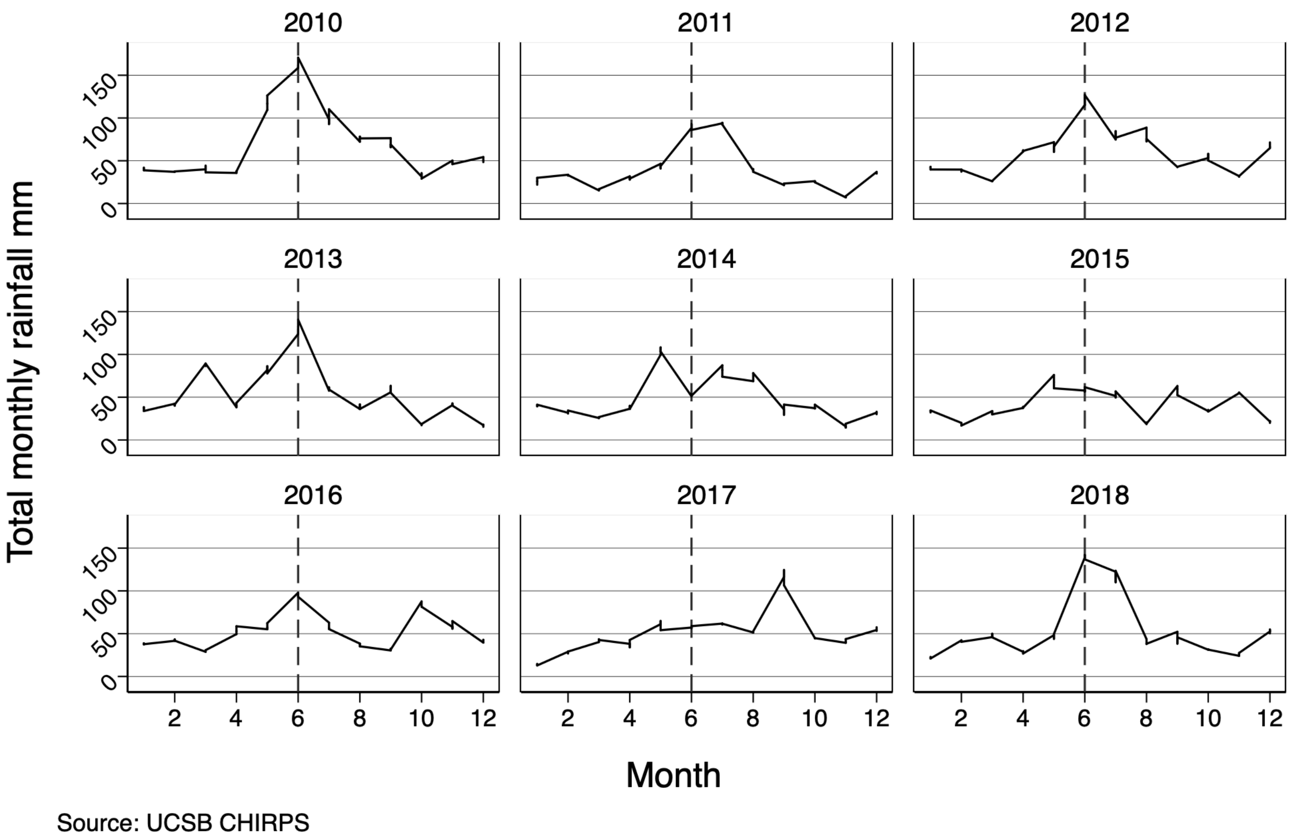


Figure 2: Experimental Design and Sample Size
(Villages, Households)

	2014			2015				2016
		June Planting	July DG Starts	November Harvest, January	June Planting	July DG Contd.	November Harvest	January
	Targeted Households = 2520	**Baseline** Households Reached = 719	**Midline** Households Reached = 2508, Households Eligible = 2013	**Endline** Households Reached = 2310, Households Eligible = 1952, Households Validated = 1896				**Endline** Households Reached = 2221, Households Eligible = 1913, Households Validated = 1913
Control:	140, 840	31%, 28%	97%, 82%	96%, 77%				96%, 78%
DG only:	70, 420	37%, 32%	93%, 76%	91%, 70%				93%, 71%
DG + labor:	70, 420	27%, 23%	94%, 79%	94%, 74%				94%, 75%
DG + self:	70, 420	30%, 26%	94%, 77%	91%, 71%				91%, 72%
DG + both:	70, 420	41%, 35%	97%, 82%	97%, 81%				97%, 81%

The baseline was compromised due to mud slides and difficulty reaching nearly half the targeted sample. Reached refers to households who could have been contacted and were interviewed. Eligible refers to households who consented to the survey and who grew rice in the previous year. Validated refers to the number of households whose self-reported output values cross-checked between their total reported output and their disaggregated output in terms of sold, consumed, stored, and shared paddy within a margin of error of 100 kilograms. One question of concern is whether the intervention itself affected farmers' consistency in reporting yields. We test whether the intervention had a statistically significant effect in explaining reporting inconsistencies (= 1 if there was a reporting inconsistency and = 0 otherwise) for yields and find no evidence of this (pvalue from Ftest across all treatment groups = 0.46).

Figure 3: Total Monthly Rainfall by Year



Baseline Summary Statistics, by Treatment Assignment
Means and Standard Errors

VARIABLE	Control	DG only	DG · labor	DG · self-efficacy	DG · both	F-stat p-value
Panel A: Farm	(1)	(2)	(3)	(4)	(5)	(6)
Paddy Acres	1.7	1.84	2	1.75	1.82	0.93
	(0.12)	(0.15)	(0.24)	(0.16)	(0.12)	
Heard of SRI (y/n)	0.33	0.3	0.28	0.33	0.32	0.97
	(0.03)	(0.04)	(0.05)	(0.05)	(0.04)	
Labor Days	43.68	51.92	66.12	35.33	44.21	0.05
	(2.80)	(5.69)	(13.66)	(3.41)	(3.54)	
Hired Wages	2.20	2.72	2.77	1.56	2.05	0.009
(Rps thousands)	(0.17)	(0.29)	(0.29)	(0.22)	(0.18)	
Expenditures	1.24	1.18	1.39	1.00	1.25	0.77
(Rps thousands)	(1.44)	(1.58)	(2.68)	(1.91)	(1.96)	
Rice Output (Kgs)	6.04	7.00	5.42	7.30	6.14	0.81
(Rps hundreds)	(0.63)	(0.82)	(0.80)	(1.22)	(0.57)	
Estimated Profit*	1.24	1.34	-4.25	5.62	0.13	0.20
(Rps thousands)	(2.71)	(2.05)	(3.15)	(3.10)	(2.12)	
Rented-in Land	2.72	2.66	3.13	2.90	1.69	0.45
(Rps thousands)	(0.61)	(0.53)	(1.30)	(0.57)	(0.38)	
Rented-out Land	351.79	122.14	1173.91	553.27	640.97	0.14
	(197.80)	(70.25)	(608.23)	(298.81)	(443.27)	
Panel B: Non-Farm	(1)	(2)	(3)	(4)	(5)	(6)
Total Debt	2.25	1.61	2.65	1.98	1.79	0.37
(Rps thousands)	(3.39)	(2.07)	(6.67)	(2.98)	(2.29)	
Total Credit	1.65	1.00	2.68	1.26	1.79	0.45
(Rps thousands)	(0.51)	(0.34)	(0.86)	(0.60)	(0.75)	
Off-farm Wages (Rps)	9.52	11.02	13.35	9.38	10.96	0.35
(Rps thousands)	(0.96)	(1.12)	(1.97)	(1.17)	(1.03)	
Business Income (Rps)	4.22	3.67	3.70	3.23	1.91	0.10
(Rps thousands)	(0.78)	(0.93)	(0.97)	(0.97)	(0.50)	
Annual Income (Rps)	4.21	4.08	4.54	4.14	3.97	0.90
(Rps thousands)	(2.72)	(2.37)	(4.82)	(3.62)	(2.02)	
HHD head age	46.52	48.74	48.46	48.76	47.99	0.47
	(0.89)	(1.19)	(1.30)	(1.27)	(1.04)	
SHG membership (years)	3.35	3.16	3.66	3.72	3.3	0.47
	(0.13)	(0.17)	(0.22)	(0.14)	(0.13)	
Observations	231	131	93	108	149	

Standard errors, clustered at the village level, reported in parentheses. All agricultural outcomes for the baseline are retrospective reports for the previous year's season 2013-2014. Labor days are the number of family person days worked for the entire season. Hired Labor is the total amount spent on hired labor for the entire season. Expenditures are the total amount spent on inputs including seed, fertilizer, machine rentals, and water pumping for the entire season. Off-farm wages and business income are additional earnings accumulated in the last 6 months. Estimated Profit, Column 7, is a constructed variable and is equal to harvest storedxp_r + harvest soldxp_f - total expenditures - hired labor, where p_f is the reported farm gate price at which a farmer sold her rice, and p_r is the estimated retail price each year (25.6 Rps/kgs and 27.8 Rps/kgs from (Bhoi et al., 2019)). For a detailed breakdown of profits by year see Appendix A.

Table 2: Outcomes per Acre

				Year One				
MODEL	Probit	Tobit	OLS	OLS	OLS	OLS	OLS	OLS
VARIABLES	Adoption	Adoption	Labor Days	Hired Labor	Expenditures	Rice Yield	Estimated Profits	Debt
	Y/N	Index	Kgs/acre	Rps/acre	Rps/acre	Kgs/acre	Rps/acre	Rps/acre
Panel A: Any DG	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Any DG	0.05*	0.23*	1.80	1,719.12	594.10	313.80*	3,268.28	-5,356.99
	(0.02)	(0.13)	(43.46)	(1,503.69)	(2,475.16)	(160.45)	(3,734.57)	(10,396.59)
Panel B: DG by Treatment	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DG only	0.04	0.23	-6.70	1,193.13	-1,189.50	526.32*	8,766.88**	-9,951.53
	(0.03)	(0.17)	(58.40)	(2,558.68)	(3,035.95)	(298.73)	(4,055.29)	(13,737.48)
DG · labor	0.07*	0.33*	-51.54	1,460.52	-528.91	147.29	233.12	-13,550.28
	(0.04)	(0.17)	(43.88)	(1,951.99)	(3,417.38)	(262.27)	(4,361.91)	(11,960.99)
DG · self-efficacy	0.02	0.11	84.08	5,430.27	3,626.43	85.23	-8,069.08	-5,433.16
	(0.03)	(0.19)	(93.40)	(3,760.15)	(5,136.59)	(181.80)	(7,241.51)	(12,498.36)
DG · both	0.05	0.23	-10.03	-686.56	635.48	476.97	10,745.63*	6,252.81
	(0.03)	(0.17)	(47.90)	(1,393.61)	(2,998.28)	(305.29)	(5,748.88)	(15,746.34)
Control Group Mean	0.10**	0.07**	276.58***	9,057.97***	19,557.22***	1,123.56***	-560.77	65,304.22***
	(0.01)	(0.01)	(35.07)	(975.15)	(1,916.66)	(98.67)	(2,883.80)	(9,031.29)
				Year Two				
Panel C: Any DG	(1)	(2)	(3)‡	(4)‡	(5)‡	(6)	(7)‡	(8)
ITT	0.04*	0.15	8.90	1,285.86	2,032.86**	358.23*		12,579.80
	(0.02)	(0.14)	(9.66)	(1,019.60)	(973.54)	(190.74)		(12,070.54)
Panel D: DG by Treatment	(1)	(2)	(3)‡	(4)‡	(5)‡	(6)		(8)
DG only	0.05*	0.24	-4.97	374.30	-52.62	187.97		-5,726.58
	(0.03)	(0.19)	(9.33)	(952.14)	(995.63)	(273.24)		(13,995.63)
DG · labor	0.04	0.19	-0.03	1,072.42	2,991.41*	308.98		6,232.38
	(0.03)	(0.19)	(9.44)	(1,222.77)	(1,674.18)	(367.12)		(17,713.90)
DG · self-efficacy	0.02	0.15	23.86	3,163.25	2,934.31	470.28		6,354.41
	(0.03)	(0.18)	(23.18)	(3,130.70)	(1,960.07)	(361.93)		(14,066.11)
DG · both	0.04	0.04	15.14	542.14	2,179.16	449.82		39,713.14*
	(0.03)	(0.18)	(17.16)	(1,001.17)	(1,748.14)	(300.44)		(23,359.53)
Control Group Mean	0.10***	0.05***	75.10***	3,643.29***	7,434.84***	1,176.06***		66,227.36***
	(0.02)	(0.01)	(6.04)	(527.33)	(586.26)	(112.58)		(9,184.42)
Observations	1,913	1,913	1,913	1,913	1,913	1,678		1,678

*** p<0.01, ** p<0.05, * p<0.1 Standard errors, clustered at the village level, reported in parentheses. Column (1) and (2) report marginal effects from a probit, and the control group mean and standard error represents the mean adoption for the control group. Column (3) represents the number of family person days per acre worked during land preparation (nursery, transplant, weeding) and harvest (pesticide, harvest, thrashing, cleaning). Column (4) represents the total expenditures per acre spent on hired labor during land preparation and harvest tasks for Year One, and for harvest tasks only in Year Two. Column (5) represents the total expenditures per acre spent on inputs including seed, animals, fertilizer, machine rentals, and irrigation in Year One and fertilizer and machine rental and irrigation in Year Two. Estimated Profit, Column 7, is a constructed variable and is equal to harvest stored x p_r + harvest sold x p_f - total expenditures - hired labor, where p_f is the reported farm gate price at which a farmer sold her rice, and p_r is the estimated retail price each year (25.6 Rps/kgs and 27.8 Rps/kgs from (Bhoi et al., 2019)). ‡ Profits are unavailable in Year Two due to incomplete input costs. In Year Two we did not conduct a midline survey, thus columns 4-5 reflect endline (harvest) costs only.

Table 3: Outcomes per Farm

MODEL VARIABLES	Probit Adoption Y/N	Tobit Adoption Index	OLS Labor Days	OLS Hired Labor Rps	OLS Expenditures Rps	OLS Rice Output Kgs	OLS Estimated Profits Rps*	OLS Debt Rps
Year One								
Panel A: Any DG	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Any DG	0.05*	0.23*	-3.10	-182.17	-219.26	117.21	2,812.16*	940.30
	(0.02)	(0.13)	(6.84)	(467.46)	(567.71)	(73.15)	(1,490.84)	(1,744.03)
Panel B: DG by Treatment	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DG only	0.04	0.23	-2.06	-859.58*	-770.08	261.67*	6,692.13***	-3,842.11*
	(0.03)	(0.17)	(9.98)	(508.28)	(759.66)	(137.35)	(2,295.65)	(2,110.57)
DG · labor	0.07*	0.33*	-0.54	114.04	556.22	92.02	659.77	448.42
	(0.04)	(0.17)	(9.44)	(562.08)	(877.56)	(112.91)	(2,003.40)	(2,812.45)
DG · self-efficacy	0.02	0.11	-7.08	419.45	-369.22	-2.55	183.26	1,932.15
	(0.03)	(0.19)	(10.42)	(988.33)	(840.56)	(90.17)	(2,110.04)	(2,240.71)
DG · both	0.05	0.23	-2.85	-392.82	-319.96	118.83	3,690.18*	4,623.77
	(0.03)	(0.17)	(9.03)	(522.22)	(734.92)	(115.93)	(2,192.84)	(3,075.14)
Control Group Mean	0.10**	0.07**	112.51***	4,485.20***	8,735.76***	684.47***	1,010.32	19,509.46***
	(0.01)	(0.01)	(5.58)	(378.52)	(462.39)	(51.47)	(1,174.78)	(1,301.55)
Year Two								
Panel C: Any DG	(1)	(2)	(3)‡	(4)‡	(5)‡	(6)	(7)‡	(8)
Any DG	0.04*	0.15	2.27	345.19	-1,579.22	15.97		3,982.97**
	(0.02)	(0.14)	(3.41)	(366.69)	(2,002.21)	(110.96)		(1,915.14)
Panel D: DG by Treatment	(1)	(2)	(3)‡	(4)‡	(5)‡	(6)	(7)‡	(8)
DG only	0.05*	0.24	1.17	549.60	-1,454.38	43.91		-376.23
	(0.03)	(0.19)	(5.20)	(616.28)	(2,045.49)	(169.94)		(2,596.43)
DG · labor	0.04	0.19	3.47	306.42	-878.60	73.00		3,047.69
	(0.03)	(0.19)	(4.66)	(574.67)	(2,050.10)	(162.96)		(3,560.65)
DG · self-efficacy	0.02	0.15	2.91	69.54	-1,924.01	-50.73		3,882.05
	(0.03)	(0.18)	(5.43)	(504.57)	(2,023.62)	(129.62)		(2,648.73)
DG · both	0.04	0.04	1.57	454.61	-1,989.26	2.62		8,710.98**
	(0.03)	(0.18)	(4.58)	(567.72)	(2,018.57)	(140.87)		(3,599.91)
Control Group Mean	0.10***	0.05***	40.31***	2,325.18***	6,097.62***	864.53***		20,317.75***
	(0.02)	(0.01)	(2.71)	(268.98)	(1,993.49)	(94.14)		(1,218.47)
Observations	1,913	1,913	1,913	1,913	1,913	1,913		1,913

*** p<0.01, ** p<0.05, * p<0.1 Standard errors, clustered at the village level, reported in parentheses. Column (1) and (2) report marginal effects from a probit, and the control group mean and standard error represents the mean adoption for the control group. Column (3) represents the number of family person days worked in the during land preparation (nursery, transplant, weeding) and harvest (pesticide, harvest, thrashing, cleaning). Column (4) represents the total expenditures spent on hired labor during land preparation and harvest tasks for Year One, and for harvest tasks only in Year Two. Column (5) represents the total expenditures spent on inputs including seed, animals, fertilizer, machine rentals, and irrigation in Year One and fertilizer and machine rental and irrigation in Year Two. Estimated Profit, Column 7, is a constructed variable and is equal to harvest storedxp_r + harvest soldxp_f - total expenditures - hired labor, where p_f is the reported farm gate price at which a farmer sold her rice, and p_r is the estimated retail price each year (25.6 Rps/kgs and 27.8 Rps/kgs from (Bhoi et al., 2019)). ‡ Profits are unavailable in Year Two due to incomplete input costs. In Year Two we did not conduct a midline survey, thus columns 4-5 reflect online endline (harvest) costs.

Table 4: What input do you think costs more
with SRI versus Traditional?

	Year One			
VARIABLES	Seed	Fertilizer	Water	Labor
Panel A: Any DG	(1)	(2)	(3)	(4)
Any DG	-0.01	0.02	0.03*	0.02
	(0.02)	(0.02)	(0.02)	(0.02)
Panel B: DG by Treatment	(1)	(2)	(3)	(4)
DG only	-0.02	0.01	0.02	0.01
	(0.02)	(0.03)	(0.02)	(0.03)
DG · labor	-0.01	0.01	0.03	-0.01
	(0.02)	(0.03)	(0.02)	(0.03)
DG · self-efficacy	0.01	0.05	0.04	0.07**
	(0.03)	(0.03)	(0.03)	(0.03)
DG · both	-0.03	0.01	0.03	-0.01
	(0.02)	(0.03)	(0.03)	(0.03)
Control Group Mean	0.12***	0.17***	0.10***	0.20***
	(0.01)	(0.02)	(0.01)	(0.02)
Observations	1,882	1,882	1,882	1,882
	Year Two			
Panel C: Any DG	(1)	(2)	(3)	(4)
Any DG	0.01	0.01	0.02	0.03
	(0.01)	(0.02)	(0.01)	(0.03)
Panel D: DG by Treatment	(1)	(2)	(3)	(4)
DG only	0.02	0.00	0.00	0.02
	(0.02)	(0.02)	(0.02)	(0.05)
DG · labor	0.00	-0.01	0.04	0.06
	(0.01)	(0.02)	(0.03)	(0.04)
	(0.01)	(0.02)	(0.03)	(0.04)
DG · self-efficacy	0.02	0.03	0.02	0.03
	(0.02)	(0.03)	(0.02)	(0.04)
DG · both	0.02	-0.00	0.02	0.00
	(0.02)	(0.02)	(0.02)	(0.04)
Control Group Mean	0.04***	0.12***	0.08***	0.48***
	(0.01)	(0.01)	(0.01)	(0.03)
Observations	1,913	1,913	1,913	1,913

*** p<0.01, ** p<0.05, * p<0.1 Standard errors, clustered at the village level, reported in parentheses. Outcomes are binary variables where yes = 1 and no = 0.

Table 5: Total off-farm Labor Days, Wages
and Own Business Income in Last 5 months per Farm

	Year One		
VARIABLES	Off-farm Work Days	Off-farm Wages	Business Income
Panel A: Any DG	(1)	(2)	(3)
Any DG	-10.24*	-4,578.64***	-372.77
	(5.38)	(1,556.43)	(1,298.05)
Panel B: DG by Treatment	(1)	(2)	(3)
DG only	-6.29	-3,142.43	-945.41
	(8.12)	(2,445.58)	(1,628.52)
DG · labor	-12.10	-5,691.85***	-687.76
	(7.76)	(1,905.76)	(1,526.86)
DG · self-efficacy	-6.33	-4,182.53**	252.35
	(7.64)	(1,826.74)	(1,565.31)
DG · both	-15.33**	-5,144.46***	-139.43
	(6.85)	(1,792.87)	(1,632.66)
Control Group Mean	109.82***	21,903.58***	6,209.69***
	(4.41)	(1,380.56)	(1,184.60)
Observations	1,896	1,896	1,896
	Year Two		
Panel C: Any DG	(1)	(2)	(3)
Any DG	-1.13	-2,165.75	-251.36
	(3.72)	(1,497.51)	(647.53)
Panel D: DG by Treatment	(1)	(2)	(3)
DG only	-3.20	-1,263.21	-984.60
	(5.46)	(2,259.47)	(882.83)
DG · labor	3.62	-1,731.85	-285.67
	(5.40)	(2,095.69)	(977.39)
DG · self-efficacy	0.11	-1,654.35	-52.31
	(4.99)	(1,986.82)	(889.17)
DG · both	-4.65	-3,808.39**	236.44
	(4.97)	(1,703.36)	(952.59)
Control Group Mean	69.22***	18,736.84***	5,308.43***
	(3.07)	(1,285.44)	(521.22)
Observations	1,913	1,913	1,913

*** p<0.01, ** p<0.05, * p<0.1 Standard errors, clustered at the village level, reported in parentheses. Outcomes are binary variables where yes = 1 and no = 0.

Table 6: Who is Responsible for my Life?

	Year One					
VARIABLES	Myself	Parents	Husband	Relatives	God	Luck
Panel A: Any DG	(1)	(2)	(3)	(4)	(5)	(6)
Any DG	-0.03	0.01	-0.02	-0.00	-0.01	-0.01
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Panel B: DG by Treatment	(1)	(2)	(3)	(4)	(5)	(6)
DG only	-0.03	-0.00	-0.01	-0.00	-0.06**	-0.04**
	(0.03)	(0.01)	(0.03)	(0.01)	(0.03)	(0.01)
DG · labor	-0.06*	0.01	-0.03	0.00	-0.02	-0.00
	(0.03)	(0.01)	(0.03)	(0.01)	(0.03)	(0.02)
DG · self-efficacy	-0.01	0.02	-0.03	-0.01	0.01	-0.01
	(0.03)	(0.01)	(0.03)	(0.01)	(0.03)	(0.02)
DG · both	-0.03	0.00	-0.00	-0.01	0.02	-0.00
	(0.03)	(0.01)	(0.03)	(0.01)	(0.03)	(0.02)
Control Group Mean	0.29***	0.02***	0.81***	0.01***	0.16***	0.07***
	(0.02)	(0.01)	(0.02)	(0.00)	(0.02)	(0.01)
Observations	1,896	1,896	1,896	1,896	1,896	1,896
	Year Two					
Panel C: Any DG	(1)	(2)	(3)	(4)	(5)	(6)
DG any	0.02**	-0.00	-0.02	-0.01**	0.00	0.00
	(0.01)	(0.00)	(0.02)	(0.00)	(0.01)	(0.00)
Panel D: DG by Treatment	(1)	(2)	(3)	(4)	(5)	(6)
DG only	0.03*	-0.01	-0.03	-0.01	0.01	0.00
	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.00)
DG · labor	0.01	0.01	-0.02	-0.02*	0.01	0.00
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.00)
DG · self-efficacy	0.02	-0.01	-0.01	-0.01	0.01	0.00
	(0.02)	(0.01)	(0.03)	(0.01)	(0.01)	(0.00)
DG · both	0.03**	-0.00	-0.02	-0.01	-0.02	0.01
	(0.01)	(0.01)	(0.03)	(0.01)	(0.01)	(0.00)
Control Group Mean	0.08***	0.05***	0.72***	0.03***	0.07***	0.00
	(0.01)	(0.00)	(0.02)	(0.00)	(0.01)	(0.00)
Observations	1,913	1,913	1,913	1,913	1,913	1,913

*** $p<0.01$, ** $p<0.05$, * $p<0.1$ Standard errors, clustered at the village level, reported in parentheses. Outcomes are binary, yes = 1, no = 0, responses.

A Appendix: Input Tables

Table A.1: Midline Summary Statistics per Farm, by Treatment Assignment, Means and Standard Errors

VARIABLE	Control	DG only	DG · labor	DG · self-efficacy	DG · both	F-stat p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Hhd size	7.1	6.79	6.96	6.9	6.94	0.65
	(0.12)	(0.17)	(0.17)	(0.16)	(0.18)	
Owns TV	0.12	0.13	0.11	0.14	0.13	0.87
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	
Rooms in house	2.97	3.08	2.9	2.98	3.19	0.35
	(0.06)	(0.11)	(0.09)	(0.09)	(0.10)	
Has electricity	0.54	0.51	0.55	0.65	0.58	0.07
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	
Age of home	12.75	14.46	13.65	12.91	12.7	0.67
	(0.56)	(0.86)	(0.92)	(0.86)	(0.80)	
Owns irrigation pump	0.13	0.14	0.18	0.14	0.14	0.63
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	
Owns tractor	0.01	0.01	0.02	0.01	0.03	0.35
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	
Grass thatched roof	0.27	0.3	0.28	0.29	0.29	0.95
	(0.02)	(0.03)	(0.03)	(0.03)	(0.02)	
Mud wall	0.19	0.24	0.21	0.19	0.2	0.56
	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	
Owns kerosene tank	0.15	0.12	0.16	0.14	0.14	0.75
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	
Paddy Acreage	0.85	0.84	0.89	0.87	0.86	0.99
	(0.04)	(0.06)	(0.06)	(0.07)	(0.05)	
Observations	649	294	311	297	343	

*** p<0.01, ** p<0.05, * p<0.1 Standard errors, clustered at the village level, reported in parentheses. Variables are binary responses, yes = 1 and no = 0.

Table A.2: Baseline Profits (Rps) per Farm, Means and Standard Errors

VARIABLE	Control	DG only	DG · labor	DG · self-efficacy	DG · both	F-stat p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Rented Livestock	38.64	67.04	26.38	8.33	48.05	0.12
	(11.73)	(34.80)	(16.69)	(5.90)	(18.87)	
Total Rented Machinery	3182.31	3311.11	3467.45	2568.15	3273.88	0.53
	(279.22)	(382.15)	(456.65)	(286.62)	(383.33)	
Seed	832.58	921.89	715.3	811.9	907.95	0.64
	(72.22)	(94.70)	(100.67)	(100.08)	(90.86)	
Irrigation	3140.5	3128.05	3405.48	2878.16	2703.15	0.66
	(233.01)	(325.42)	(412.06)	(323.24)	(249.21)	
Fertilizer	5210.27	4418.17	6378.8	3772.82	5589.14	0.90
	(1330.25)	(1413.89)	(2452.84)	(1637.10)	(1731.18)	
Labor Expenses	(1)	(2)	(3)	(4)	(5)	(6)
Total Wages	2206.76	2728.81	2778.88	1566.57	2059	0.009
	(174.80)	(295.30)	(299.73)	(223.59)	(180.70)	
Nursery	122.59	171.41	169.63	58.8	103.36	0.01
	(15.51)	(27.50)	(33.42)	(15.25)	(18.24)	
Land Preparation	295.19	435.78	339.1	188.02	289.03	0.03
	(32.78)	(59.07)	(57.98)	(43.42)	(44.05)	
Transplantation	540.56	631.13	777.02	421.95	624.26	0.03
	(46.71)	(80.90)	(108.19)	(56.61)	(69.62)	
Weeding	409.53	560.63	516.7	363.61	368.19	0.11
	(37.63)	(69.88)	(74.85)	(56.76)	(42.88)	
Water Pumping	98.3	121.85	160.64	55.74	58.93	0.03
	(14.06)	(29.61)	(32.69)	(16.64)	(14.29)	
Pesticide	89.78	125.81	129.52	84.77	72.38	0.26
	(12.49)	(30.09)	(27.53)	(18.09)	(10.93)	
Harvest	630.3	678.5	656.49	386.28	542.25	0.24
	(80.13)	(105.05)	(109.74)	(91.47)	(75.42)	
Other	20.52	3.7	29.79	7.41	0.6	0.03
	(6.88)	(2.66)	(15.72)	(5.84)	(0.60)	
Rice Output (kgs)	604.49	700.15	542.91	730.79	614.22	0.81
	(63.06)	(82.81)	(80.38)	(122.03)	(57.50)	
Estimated Profit	1240.03	1342.95	-4259.31	5622.36	136.72	0.20
	(2718.72)	(2053.99)	(3150.73)	(3102.94)	(2122.48)	
Land Rented-in	2727.05	2661.07	3133.7	2902.05	1690.97	0.45
	(615.39)	(535.10)	(1300.36)	(571.10)	(382.91)	
Land Rented-out	351.79	122.14	1173.91	553.27	640.97	0.14
	(197.80)	(70.25)	(608.23)	(298.81)	(443.27)	
Total Debt	22540.95	16155.56	26595.74	19889.81	17924.83	0.37
	(3398.59)	(2076.18)	(6671.24)	(2982.36)	(2295.58)	
Total Credit	1651.95	1002.22	2684.04	1263.89	1793.96	0.45
	(510.61)	(344.22)	(866.57)	(605.93)	(750.64)	
Observations	232	135	94	108	149	

All agricultural outcomes for the baseline are retrospective reports for the previous year's season 2013-2014. The baseline survey did not include questions regarding hired labor expenses for cleaning and thrashing. Estimated Profit is a constructed variable and is equal to harvest stored$\times p_r$ + harvest sold$\times p_f$ - total expenditures - hired labor, where p_f is the reported farm gate price at which a farmer sold her rice, and p_r is the estimated retail price each year (25.6 Rps/kgs and 27.8 Rps/kgs from (Bhoi et al., 2019)).

Table A.3: Year One Profits (Rps) per Farm, Means and Standard Errors

VARIABLE	Control	DG only	DG · labor	DG · self-efficacy	DG · both	F-stat p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Rented Livestock	57.52	40.41	54.41	42.62	93.32	0.38
	(11.53)	(7.82)	(16.36)	(11.69)	(22.80)	
Midline Machinery	3870.69	3334.37	4332.27	3915.08	3531	0.25
	(217.63)	(240.46)	(378.42)	(385.43)	(220.88)	
Endline Machinery	215.39	357.56	207.14	241.62	258.89	0.39
	(17.01)	(57.98)	(24.04)	(33.97)	(25.02)	
Seed	1123.4	1064.75	1079.89	1064.01	1170.01	0.93
	(60.86)	(107.57)	(66.91)	(92.22)	(89.74)	
Irrigation	1576.1	1482.15	1879.87	1422.99	1347.38	0.14
	(101.11)	(115.31)	(167.00)	(93.29)	(83.92)	
Fertilizer	1892.66	1697.79	1738.4	1680.22	2015.19	0.88
	(212.85)	(143.76)	(157.81)	(249.83)	(317.78)	
Labor Expenses	(1)	(2)	(3)	(4)	(5)	(6)
Total Wages	4485.2	3625.62	4599.24	4904.65	4092.38	0.29
	(386.64)	(324.01)	(367.51)	(896.12)	(332.21)	
Nursery	153.64	127.35	148.78	192.45	156.78	0.79
	(17.50)	(21.25)	(20.72)	(59.08)	(24.34)	
Land Prep	683.33	519.69	765.99	642.77	428.59	0.07
	(104.87)	(93.04)	(118.93)	(117.58)	(53.07)	
Transplantation	1899.32	1652.16	2334.82	2481.77	2014.28	0.17
	(147.42)	(165.99)	(222.64)	(684.44)	(184.30)	
Weeding	1355.02	980.31	1025.05	1194.98	1122.39	0.35
	(163.00)	(111.92)	(96.56)	(144.98)	(122.34)	
Water Pumping	158.83	143.91	112.09	203.36	147.14	0.61
	(28.57)	(36.55)	(22.60)	(57.73)	(32.27)	
Cleaning	31.82	14.54	13.34	12.57	15.74	0.91
	(18.89)	(4.63)	(5.35)	(8.54)	(5.64)	
Pesticide	29.96	24.35	15.79	17.68	17.84	0.85
	(13.25)	(8.29)	(5.97)	(6.63)	(5.23)	
Thrashing	32.15	54.47	57.14	26.29	42.42	0.58
	(8.09)	(17.40)	(26.44)	(10.69)	(12.89)	
Harvest	81.25	55.1	62.99	50.76	90.15	0.86
	(35.14)	(19.54)	(31.41)	(18.73)	(35.22)	
Other	59.88	53.74	63.25	82.03	57.06	0.98
	(13.54)	(13.00)	(18.86)	(46.80)	(12.25)	
Rice Output (Kgs)	684.47	946.15	776.49	681.92	803.3	0.31
	(38.96)	(88.23)	(70.74)	(60.34)	(67.26)	
Estimated Profit	966.32	7639.48	1635.96	1123.28	4618.93	0.03
	(937.25)	(1303.98)	(1134.71)	(1430.32)	(1188.09)	
Land Rent In	4302.5	6515.23	5267.59	5462.36	4534.13	0.72
	(561.06)	(1311.83)	(780.77)	(1073.09)	(668.71)	
Land Rent Out	1667.19	827.3	1190.94	2853.74	1720.76	0.25
	(385.21)	(292.95)	(545.78)	(1021.47)	(546.25)	
Total Debt	19509.46	15667.35	19957.88	21441.61	24133.24	0.06
	(1268.52)	(1525.82)	(2287.13)	(2021.06)	(2707.20)	
Total Credit	387.69	167.69	228.3	114.09	368.8	0.31
	(143.07)	(82.94)	(121.48)	(57.25)	(171.55)	
Observations	650	294	311	298	343	

Estimated Profit is a constructed variable and is equal to harvest storedxp_r + harvest soldxp_f - total expenditures - hired labor, where p_f is the reported farm gate price at which a farmer sold her rice, and p_r is the estimated retail price each year (25.6 Rps/kgs and 27.8 Rps/kgs from (Bhoi et al., 2019)). Output and profits have 15 fewer observations than other outcomes due to a refusal or lack of response.

Table A.4: Year Two Profits (Rps) per Farm, Means and Standard Errors

VARIABLE	Control	DG only	DG · labor	DG · self-efficacy	DG · both	F-stat p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Endline Machine	281.37	406.7	351.55	379.21	351.57	0.39
	(22.53)	(52.85)	(48.27)	(71.45)	(61.18)	
Water	2172.26	2092	2837.62	2005.05	2053.35	0.22
	(145.92)	(175.53)	(256.85)	(162.65)	(165.69)	
Fertilizer	3643.99	2144.53	2029.85	1789.34	1703.44	0.44
Labor Expenses	(1)	(2)	(3)	(4)	(5)	(6)
	(1932.25)	(214.58)	(169.88)	(138.78)	(151.40)	
Total Wages	2325.18	2874.78	2631.59	2394.71	2779.78	0.86
	(250.24)	(456.29)	(408.17)	(354.99)	(492.25)	
Cleaning	394.29	477.73	442.46	308.26	278.21	0.32
	(63.05)	(106.07)	(97.18)	(77.16)	(59.92)	
Pesticide	175.93	242.21	198.06	160.25	155.45	0.28
	(18.15)	(32.99)	(26.11)	(21.26)	(26.64)	
Thrashing	147.31	85.7	70.76	127.71	102.05	0.80
	(48.26)	(33.20)	(28.11)	(84.40)	(57.34)	
Harvest	1252.44	1645.85	1560.08	1382.02	1758.02	0.69
	(162.63)	(360.72)	(286.75)	(221.90)	(353.42)	
Other	130.42	183.59	211.46	219.36	225.51	0.64
	(33.36)	(54.71)	(63.48)	(76.94)	(100.10)	
Rice Output (kgs)	864.53	908.44	937.53	813.8	867.14	0.95
	(72.27)	(102.52)	(90.93)	(69.57)	(71.53)	
Estimated Profit						
Land Rent In	5174.47	4550.86	4945.97	6951.46	4516.72	0.30
	(484.55)	(555.84)	(673.58)	(827.19)	(581.61)	
Land Rent Out	818.74	939.6	591.2	829.62	735.71	0.96
	(216.24)	(371.44)	(264.03)	(377.13)	(223.89)	
Total Debt	20317.75	19941.52	23365.45	24199.81	29028.74	0.10
	(1209.56)	(2227.47)	(3351.13)	(2209.27)	(3405.07)	
Total Credit	394.08	59.06	96.35	179.94	435.19	0.03
	(111.34)	(32.99)	(77.77)	(92.29)	(315.84)	
Observations	659	298	301	314	341	

A midline survey *was not* conducted in Year Two, and, therefore, questions regarding hired labor expenses for mid-season activities are omitted including: nursery bed, land preparation, transplantation, weeding, and irrigation. As a result, we cannot accurately calculate Estimated Profit in Year Two.

Table A.5: Breakdown of Rice Output (Kgs) Consumed, Stored, Sold by Year per Farm, Means and Standard Errors

VARIABLE	Control	DG only	DG · labor	DG · self-efficacy	DG · both	F-stat p-value
Baseline	(1)	(2)	(3)	(4)	(5)	(6)
Rice Output	604.49	700.15	542.91	730.79	614.22	0.81
	(63.06)	(82.81)	(80.38)	(122.03)	(57.50)	
Sold	116.59	129.24	84.32	100.65	67.11	0.64
	(34.53)	(44.87)	(29.07)	(39.16)	(21.13)	
Consumed	280.68	371.04	238.59	330.34	321.58	0.37
	(23.80)	(64.62)	(34.59)	(37.06)	(25.86)	
Stored	212.77	300	187.6	219.12	219.12	0.51
	(23.45)	(65.61)	(33.84)	(124.20)	(241.59)	
Estimated Profit (Rps)	1240.03	1342.95	-4259.31	5622.36	136.72	0.20
	(2718.72)	(2053.99)	(3150.73)	(3102.94)	(2122.48)	
Observations	232	135	94	108	149	
Year One	(1)	(2)	(3)	(4)	(5)	(6)
Rice Output	684.47	946.15	776.49	681.92	803.3	0.31
	(38.96)	(88.23)	(70.74)	(60.34)	(67.26)	
Sold	120.4	298.88	235.79	163.83	213.28	0.05
	(17.07)	(66.10)	(48.53)	(30.44)	(45.99)	
Consumed	157.91	157.72	150.81	138.69	157.37	0.86
	(11.65)	(10.02)	(10.55)	(11.02)	(9.19)	
Stored	308.47	405.23	312.22	309.56	372.01	0.55
	(22.39)	(41.02)	(31.91)	(34.83)	(32.82)	
Estimated Profit	966.32	7639.48	1635.96	1123.28	4618.93	0.03
	(937.25)	(1303.98)	(1134.71)	(1430.32)	(1188.09)	
Observations	650	294	311	298	343	
Year Two	(1)	(2)	(3)	(4)	(5)	(6)
Rice Output	864.53	908.44	937.53	813.8	867.14	0.95
	(72.27)	(102.52)	(90.93)	(69.57)	(71.53)	
Sold	291.99	372.96	366.98	274.95	282.87	0.87
	(56.65)	(86.16)	(73.81)	(46.56)	(47.22)	
Consumed	192.3	195.18	198.83	208.06	216.35	0.89
	(9.39)	(20.44)	(12.34)	(14.95)	(17.49)	
Stored	301.08	282.06	293.7	267.91	286.04	0.99
	(27.01)	(36.09)	(35.84)	(29.87)	(28.26)	
Estimated Profit (Rps)						
Observations	659	298	301	314	341	

In Year one and two, 2.9%(2.5%) of households reported that they planned to sell part (2.4% and 2.5% of total rice output) of their stored output. Average and standard deviation of monthly household rice consumption in kilograms for the baseline, year one, and year two was 49.27 (27.89), 50.60 (25.52), 48.37(23.82). Estimated Profit is a constructed variable and is equal to harvest storedxp_r + harvest soldxp_f - total expenditures - hired labor, where p_f is the reported farm gate price at which a farmer sold her rice, and p_r is the estimated retail price each year (25.6 Rps/kgs and 27.8 Rps/kgs from (Bhoi et al., 2019)).

B Appendix: Videos and Scripts

Table B.1: DG Video Description

MAIN VIDEOS
SRI Seed Treatment Video discusses how to care for seeds including: seed selection using a saline water solution; seed washing with fresh water 8-10 hours; seed treatment with bebisteen powder for 18-20 hours; and seed storage in moist sacks. A one acre plot requires 100 grams of seed as compared to the traditional method, which would require 1 kilogram of seed.
Nursery Bed Preparation Video discusses how to prepare raised nursery beds for seed planting seeds. The beds should be 10 feet length, 3 feet wide and 6 inches high, and situated next to the farmer's paddy field. The beds should contain a biomass mixed with the soil. The seeds are planted on the raised nursery beds with a spacing of 1 inch between rows.
SRI Seeding and Transplantation Video discusses the process of uprooting saplings and re-planting them in the field. Saplings are transplanted 8-10 days after nursery bed preparation. Fertilizer is applied prior to (6 kgs of biomass transplantation, and saplings are planted 10 cm apart. Watering and timing of watering are discussed.
The *Labor Message* describes the number of labor days required for the SRI method, and the gains in output from SRI. The *Self-efficacy Message* describes a farmers success with SRI, how he/she started applying SRI to part of a plot at first and then increased their coverage each year, and that they felt supported in their adoption of the technique by Village Representative Persons (VRPs).
VIDEO ACTOR INFORMATION
All video protagonists were of other backward class (OBC) with the exception of the SRI Seed Transplantation video for DG Only, who was of Scheduled Caste (SC), and the SRI Seed Treatment video for DG Only, who was of Scheduled Tribe (ST). All actors for the DG only treatment were female and 45, 32 and 53 years of age for the Purnia, Muzzafapur and Nalanda Districts respectively. All actors for the DG + Any Message treatment were male and 42, 29 and 40 years of age for the same respective list of Districts.

Script for Clip (a) Below is the script for Clip (a), 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. Dress: Actor is dressed in normal clothes worn for farming activities.

Background: Actor is standing 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.

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."