Agricultural Extension, Mobile Phones, and Outgrowing: Is it a Win-Win for Famers and Companies?

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JFS Customer & Supplier Relationship Management (CSRM) Impact Evaluation

Endline Report
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1. Executive summary

This report presents the results of the JFS Customer and Supplier Relationship Management System (CSRM) impact evaluation. JFS began CSRM implementation in November 2016 (start of 2016/17 season). The CSRM system is a two-way communication platform designed to provide farmers with important information and to strengthen company relations with farmers. It has two components - a messaging service that delivers relevant agronomic information to farmers, and a hotline to which farmers can call and make enquiries relevant to farming. With this intervention, JFS sought to increase cotton sales through greater farmer retention and improved farmer knowledge of agronomy. In addition, CSRM has the potential to improve farmer welfare by increasing earnings and knowledge of socially relevant practices.

IDinsight conducted a randomized controlled trial (RCT) to determine the effect of the CSRM program on (1) cotton production, (2) farmer retention, (3) knowledge of Good Agricultural Practices (GAPs), and (4) loan repayment.

The evaluation revealed statistically significant, encouraging first-season results.[1] In markets where CRSM was implemented, farmers:

- **Sold 12% more cotton** than those in control markets.[2] Average cotton sales increased from 163 kg to 183 kg.
- **Were more likely to sell cotton this year**. Farmers who sold cotton the previous year were 4.6 percentage points more likely to sell this season (82% in control markets versus 86.6% in treatment markets). Those who took seeds from JFS this year were 5.3 percentage points more likely to eventually sell cotton (49% in control markets versus 54.3% in treatment markets).
- **Experienced small increases in knowledge of GAPs**, with the biggest increase in knowledge of cotton planting.
- **Were 4 percentage points more likely to have fully repaid their JFS loans**. On average farmers in treatment markets repaid 80% of the loan they took compared to 76% in control markets.
- **Did <u>not</u> increase the total area dedicated to cotton** (contingent on growing cotton) **or cotton yields**.

Yet, there is potential for even larger impacts with better design and implementation. Program effectiveness was limited by certain operational barriers to implementation such as damaged phones, limited network coverage, and farmers opting to use their personal phones as their primary phones, farmers not receiving messages frequently, and farmers not contacting JFS frequently. Survey data revealed:

[1] Cotton sale, retention from one season to the next, and loan repayment were significant at the 10% level of significance; retention of farmers who took seeds to actual cotton sale and GAP knowledge of cotton planting were significant at the 5% level of significance.
[2] This number is calculated from the sample of farmers who took seeds from JFS. Roughly 50% of the farmers who took seeds from JFS did not sell any cotton, so the 12% increase comes from a relatively low base.

- Almost **24% of the farmers who received phones do not remember receiving messages** from JFS. This could be driven by:
  a) Damaged phones due to hardware issues (48% of farmers who had their phones switched off attributed it to phone not working; 42% to lack of battery)
  b) Farmers using personal phones more regularly that JFS phones. **17% of the farmers owned a personal phone and of these, about 70% reported using personal phones more regularly than the JFS phones**.
  c) Limited mobile network in some areas
- **Only a quarter of the farmers had received any message from JFS during the past week.** If farmers don't receive messages frequently, they could miss out on important information
- **Only a third of the farmers that received phones reported having contacted JFS using their phone.** Qualitative interviews revealed that the activista still serves as the main source of information for most farmers.

Mitigating these barriers could further strengthen program implementation and improve impact.

The intervention primarily impacted cotton outcomes through increased retention. While more farmers in CSRM markets chose to grow cotton and sell it to JFS, cotton farmers in CSRM markets did not produce more cotton on average nor experience greater yields. Instead, phone distribution may have increased loyalty towards JFS, driving increased production of cotton and decreasing side-selling. Farmers may also have chosen to cultivate cotton because of an expectation of higher yields due to a belief that the CRSM service was a valuable input into their cotton production.

Qualitative work also indicated that the **two-way communication between extension officers and farmers has created a more efficient extension system for JFS.** Benefits include (1) more effective input distribution to farmers, (2) faster farmer mobilization for meetings, (3) improved ability for farmers to ask questions directly to their extension officers, and (4) increased reporting of "activista"-level corruption to extension officers.

Understanding the full effectiveness of CSRM will require assessing the effects of the innovation in the following seasons. This evaluation only captured the effects of the first season of this program. As the impact of the intervention is likely to change in future seasons, fully assessing CSRM's impact will require examining retention and GAP knowledge after multiple seasons. JFS could consider examining whether there is diminishing impact from farmer retention or, if accrual of GAP knowledge translates into greater yields after multiple seasons.

We recommend continuing the program, mitigating existing operational barriers to strengthen the program, and evaluating program impact after one more season. Recommendations to improve CSRM program effectiveness include:

A. Program design and implementation
   a. **Add the farmers' personal phone numbers to the CSRM database** and send messages to these numbers as well. This could improve reach at marginal cost to JFS.
   b. **Evaluate the effectiveness of solar panels distributed in the pilot and consider distributing them to activistas in more markets**

c. **Ensure that activistas have working phones, receive their monthly allowance on time, and are trained to use phones** to facilitate communication between activistas, farmers, and JFS.
d. **Redistribute the stickers with the JFS call center number** for farmers to stick at the back of their phones.
e. **Send specific, detailed information in messages.** Farmers are likely to benefit most from targeted messages that provide all relevant details. JFS could consider, a) **notifying farmers about input distribution and usage** by sending multiple messages with detailed information ahead of time, b) **re-evaluating content of current messages to ensure sufficient details are included**

B. Program measurement
   a. **Strengthen internal data collection systems** to enhance program monitoring.
   b. **Consider continuing program evaluation to further fine-tune the program and obtain** deeper insight of its channels of impact.

IDinsight also evaluated the voice message pilot implemented by JFS in April 2017 in order to assess the optimum method of sending messages – text or voice. The evaluation had **mixed results**, including:

- There was **no significant difference in rate of receiving messages** between the two groups.
- **Voice message recipients recalled 5% more content** relative to text message recipients[3].
- There was **no significant difference in the rate of contacting JFS** between the two groups.

We recommend that JFS carefully considers the pros and cons of sending voice messages before considering adoption of voice messages. Although voice messages are 2.5 times more expensive than text messages, the higher content recall could make them more profitable than messages, especially in areas with lower literacy.

[3] This result was significant at the 10% level of significance

2. Context

Sociedade Algodoiera de Niassa (JFS-SAN), of the Mozambican family conglomerate JFS Holdings, is a cotton ginning and export company based in Cuamba District, Mozambique, where it has operated since 1939. Mozambique grants the company exclusive concession to farm and support cotton production in the district. The company supports smallholder contract farmers with services and inputs such as seeds and pesticides.

JFS-SAN is part of the TechnoServe Contract Farming R&D Coalition in which the company receives a three-year matched grant (~500,000 USD) from TechnoServe for exploring innovations—coupled with external evaluation by IDinsight—that stand to benefit farmer livelihoods as well as the company's bottom line. Evidence and lessons from explorative interventions will be shared with other companies in the coalition.

JFS is implementing a two-way mobile communication system called the Customer and Supplier Relationship Management System (CSRM) using funds received from the Contract Farming R&D Coalition. IDinsight conducted an impact evaluation of this intervention for the 2016-2017 cotton growing season. This report includes results and recommendations stemming from this evaluation.

3. Intervention overview

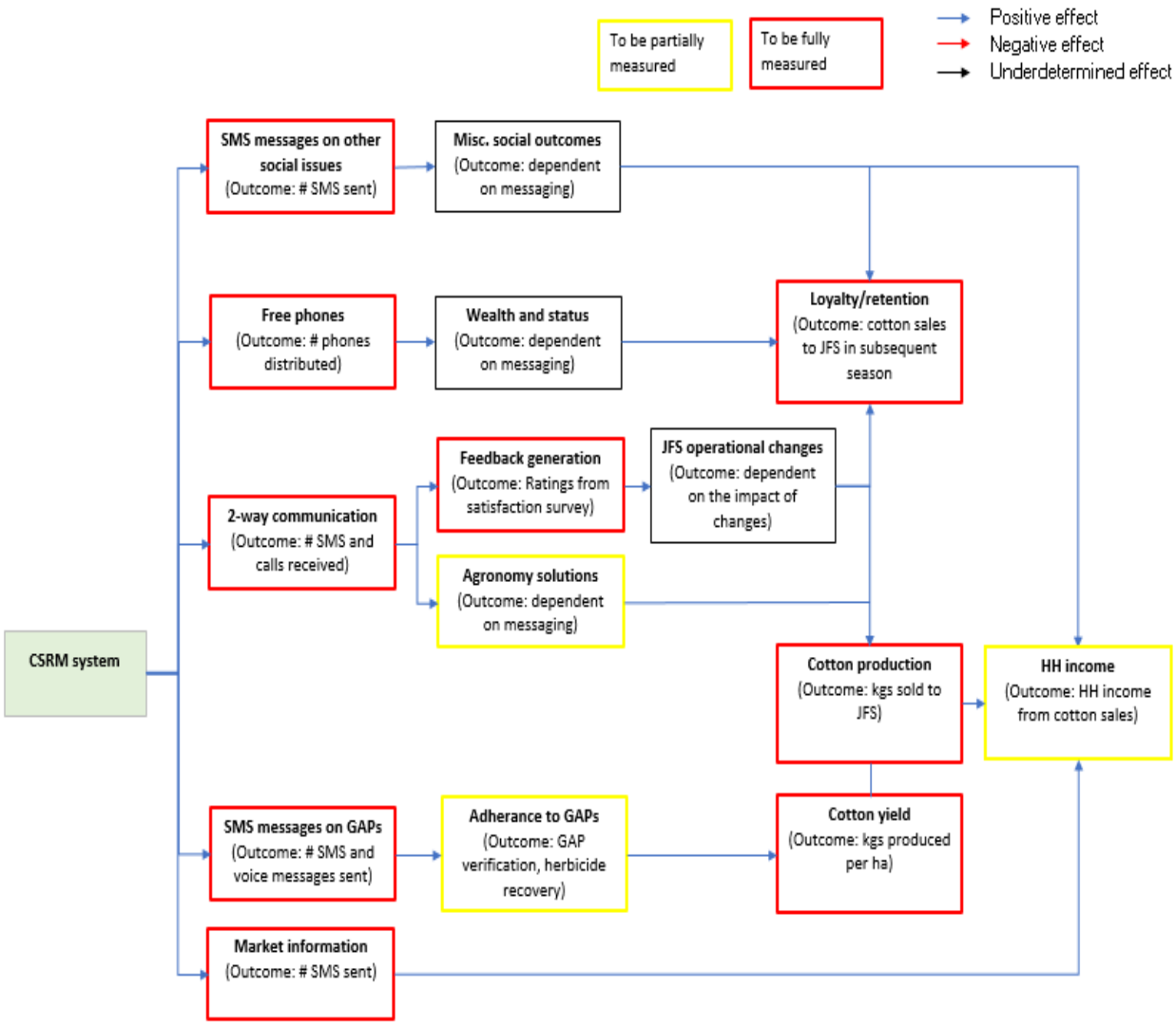
3.1 Main intervention

The mobile CSRM system is a two-way communication platform with the goal of strengthening company relations with farmers and providing an information service resource for farmers. The CSRM system has two components:

1) The CSRM communication system consists of a message-based communication platform over which JFS sends relevant information to farmers about agronomy, market information, weather, farming practices, and other beneficial information (including social and health information) according to a communication plan. These messages are delivered as text or voice messages.
2) The system has a hotline and call centre that allows farmers to call in with queries and obtain specific information relevant to farming or other issues.

A complete theory of change of the CSRM intervention is detailed in Figure 1 below:

Figure 1: CSRM's Theory of change



As detailed in the diagram above, the following outcomes of interest are expected to change as a result of the CSRM intervention:

Table 1: Channels through which CSRM will achieve its objectives

Channels	Outcomes
Timely provision of key information by SMS or voice. Simple information and reminders may be able to change behaviour for achievement of basic best practices such as timely planting and correct application of pesticides.	• Improved adoption of agronomy best practices • Improved yields (as a result of the intermediate outcome above)
Access to trained call centre operators. Farmers can receive individualized information (by phone or SMS) on specific agricultural best practices or problem-solving (e.g. dealing with crop pests).	• Improved adoption of agronomy best practices • Improved yields (as a result of intermediate outcome above) • Improved communication between farmers and JFS • Improved farmer satisfaction (as a result of all outcomes above)
Receipt of a mobile phone: Mobile phone penetration is fairly low. Use of a mobile phone may allow farmers to better communicate and receive information outside of the CSRM system that proves useful for production/yield and adoption of GAPs.	• Improved farmer satisfaction • Improved retention (i.e. reliable year-on-year selling to JFS-SAN) as a result of increased loyalty

JFS expects all these changes to eventually lead to a reduction of per-unit extension overhead over the long term.

From **Dec 2015 to April 2016 (Year 1),** JFS-SAN distributed mobile phones to approximately 5,400 farmers in 80 markets[4] to pilot the intervention. This was followed by a process evaluation by IDinsight, with recommendations[5] for potential changes to strengthen the program for the next season. After incorporating numerous process recommendations to strengthen program implementation, JFS distributed approximately 6,000 additional[6] mobile phones in 109 different[7] markets in **November 2016 (Year 2)**.

This evaluation focuses on the impact of the CSRM intervention in **Year 2 markets.**

[4] A market is similar to a small village and serves as an administrative division for buying and selling cotton.
[5] The IDinsight process evaluation recommended addressing existing problems with hardware, access to charging stations, and low literacy. Conditional on these issues being addressed, IDinsight recommended proceeding with an impact evaluation and a limited scale-up of the intervention solely in Cuamba district, allowing JFS to focus resources on maximizing the potential of the intervention.
[6] New phones were distributed as the IDinsight process evaluation found that the year 1 batch of phones were of very poor quality which seriously limited impact of the intervention.
[7] There are 4 markets that received phones in both year 1 and year 2, however, all other markets from year 2 are different to the markets included in the year 1 pilot.

3.2 Voice vs text messages pilot

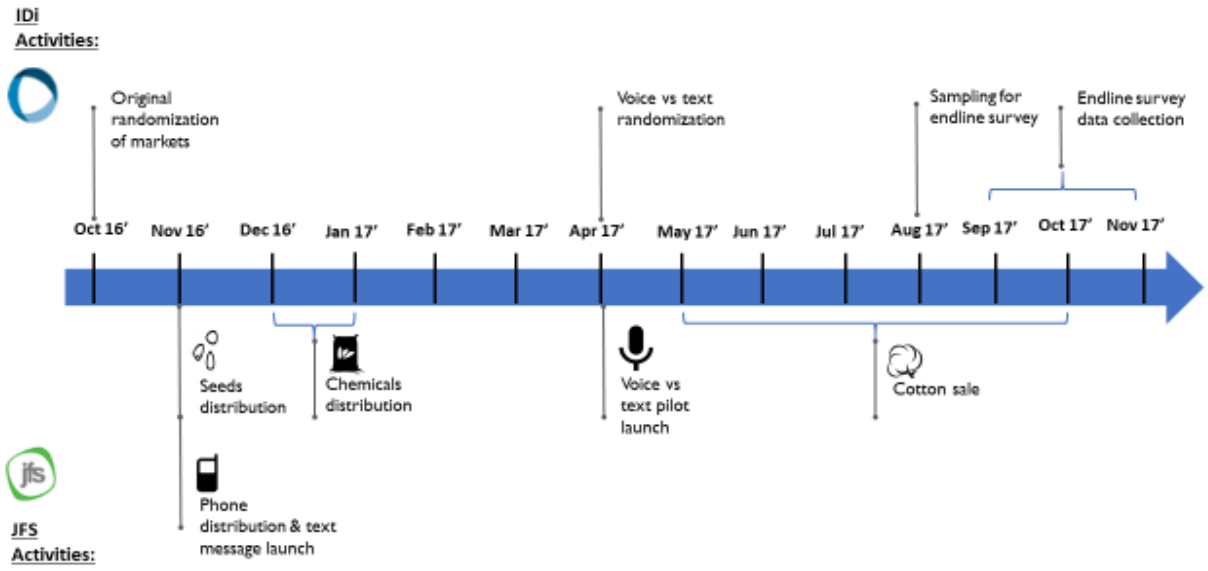
In April 2017, JFS decided to conduct a pilot using voice messages as an alternative to text-based communication as voice messages may be more accessible to populations with low literacy rates. Voice-based mobile communication has been shown to be effective in communicating information to farmers, in particular among farmers in rural areas (Payne, Woodard, & IRIS, 2010; International Rice Research Institute (IRRI), 2011).

In addition to the main evaluation, IDinsight also evaluated this pilot to assess which type of message is more effective in this context.

4. Evaluation timeline and program implementation

The program was launched in November 2016 when JFS distributed approximately 6000 phones in 109 different markets and launched the messaging component. The phones were distributed immediately after seeds were given out to farmers for the 2016/17 season. The distribution was based on randomization conducted by IDinsight on October 2016. The messaging program has continued from October 2016 to date. JFS also launched the voice message pilot in 15 markets in April 2017 – this pilot continued for 6 months till October 2017. An endline survey was conducted from September to November 2017, towards the end of the cotton season, in order to capture maximum cotton sales in the evaluation markets. A detailed timeline is illustrated in Figure 2 below.

Figure 2 : Evaluation timeline



5. Evaluation 1- Large-scale impact evaluation

5.1 Evaluation objective

The specific goals of this evaluation are to measure the impact of the CSRM system on cotton production and producer retention (primary outcomes). Impact on secondary outcomes - loan repayment and knowledge of good agricultural practices (GAPs) amongst farmers - was also measured. In theory, improvements in these outcomes imply benefits for both farmers and JFS-SAN.

5.2 Evaluation methodology

5.2.1 Research questions and outcomes

The evaluation was designed to answer the following research questions:

Table 2: Research questions and outcomes of large scale impact evaluation

Outcomes	Research questions	Indicators
Primary outcomes		
Cotton production	Do treatment farmers have significant increases in cotton production?	• Cotton sold (kg) • Cotton income (MZN) • Cotton yield (kg/ha)
Producer retention	Does treatment lead to higher farmer retention?	• Number of cotton sellers in the market • Number of farmers selling cotton in consecutive years (2016 and 2017) • Number of farmers who took seeds that actually planted cotton
Secondary outcomes		
Knowledge of good agricultural practices	Do treatment farmers have significant increases in knowledge of GAPs?	• Index representing farmer knowledge of GAPs for cotton planting, watering, harvesting, pest-management, post-harvest management and cotton prices (topics on which JFS sends SMS messages to farmers)
Loan repayments	Are treatment farmers more likely to repay their loans?	• Proportion of loan amount repaid off • Number of farmers who have paid off part or all of their loans

This evaluation also assessed relevant operational outcomes to assess implementation of the program (see Table 3). Operational outcomes did not compare results between treatment and control markets and only assessed farmers in treatment markets who were interacting with the program.

Table 3: Research questions and outcomes for operational outcomes

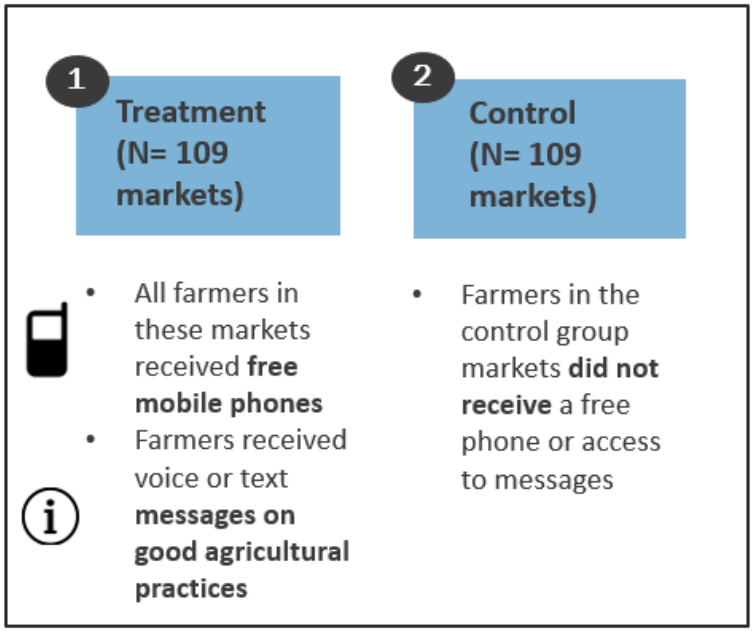
Outcomes	Research questions	Indicators
Platform engagement	How are farmers engaging with the system?	• Proportion of farmers contacting JFS • Number of times farmers contact JFS
Phone use	How are farmers using their phones?	• Proportion of farmers with a working phone at the end of the season • Reasons for not utilizing their phones
Customer satisfaction	Are farmers satisfied with the CSRM system?	• Reported satisfaction with the CSRM system

5.2.2 Research design

This evaluation was a **two-armed clustered randomized controlled trial (RCT)**, clustered at the market-level.

The objective of this design was to create a comparison group that mimics as closely as possible how the treatment group—in this case, the farmers that received phones—would perform in the absence of treatment—that is, if they had not received phones. In order to achieve this, some markets in the sampling frame were randomly assigned to receive phones and a similar number were assigned to not receive phones (see Figure 3).

Figure 3 :Study arms



This evaluation has a cluster design as the CSRM intervention was expected to have spillover effects[8] on farmers that didn't receive phones within markets in which some farmers receive phones. These spillover effects could have potentially contaminated the outcomes of control group farmers (who didn't receive phones). In order to estimate an unbiased estimate of program impact, we assigned entire markets as a treatment or control market.

Compliance across the study sample was not perfect.

- 3 markets that were supposed to receive treatment did not, and 2 originally control markets did receive treatment.
- Additionally, not everyone in the treatment villages ended up getting a phone as they needed to be present on the day of distribution in order to receive one. 83% of the farmers in the treatment group reported actually receiving phones. Additionally, 4.5% of the farmers in the control group also received phones.

We have hence decided to consider an Intention-to-Treat (ITT) framework and all estimates presented in this report are ITT estimates.

5.2.3 Data Sources

There were three data sources:

1. **Household survey:** The primary data source was a farmer survey, designed and conducted by IDinsight. Table 4 below briefly outlines the contents of this survey.

[8] Spillover effects are effects in one context that occur as a result of something else in a different context. For e.g. in this case, if farmers in the same market were assigned to treatment and control arms, then farmers that received treatment could have interacted with control farmers and lead to a change in outcomes for control farmers as well.

Table 4: Farmer survey contents

Farmer information	**Name(s), phone number, age, gender, level of education**
JFS phones status	Receipt of JFS phone, phone status (on/off)
Phone usage	What farmers used their phone for, network coverage in the area
Interaction with the CSRM program	Number of times farmers received messages from JFS, type of messages received, number of times farmers contacted JFS, and the nature of enquiries
Farmer satisfaction	Farmer satisfaction with the CSRM program, reasons for enjoying/not enjoying the program
Cotton production	Cotton sales in 2016, land size
Knowledge of good agricultural practices	Series of eleven questions to assess knowledge of farming emphasized by JFS in messages
JFS radio program	Access to the JFS radio program and program content

2. **Administrative data:** Administrative data is collected by JFS staff during distribution of inputs or sales and is recorded in excel documents. Data included information on cotton sales, cotton yield, self-reported land-size, input distribution, and loan repayment records for all farmers who took seeds in the 2016/2017 cotton season.

3. **Qualitative data**: Semi-structured interviews were conducted with 13 farmers and 8 Activistas across 8 markets. We also interviewed two members[9] of the CSRM team to gain a better understanding of the barriers to phone usage, farmer engagement to the CSRM program, and the daily operations of the CSRM system.

5.2.4 Sampling

Sampling frame: The original randomization of markets was done from a sampling frame of 386 markets, which constituted nearly all the markets serviced by JFS in the Cuamba region. 109 markets from this sample were randomized into the treatment arm and 109 were randomized into the control arm. Markets that were deemed too rural to effectively implement the treatment and any markets that were involved in the evaluation of a parallel study on concentration farming were excluded from this sample.

Arm assignment: The sample was stratified on variables that were expected to be correlated with study outcomes:

1) Agency - unit of geography composed of multiple markets that JFS uses to describe the area that one extension officer ('Tecnico') is responsible for. The size of an agency varies between 16-51 markets.

[9] The CSRM call centre advisor and CSRM program co-ordinator were interviewed.

2) Access to charging panel - binary variable that classifies markets based on access to a charging panel. Access was defined as having a charging panel within a 60- minute walking radius.

Evaluation sample: The final sample for the survey and administrative data is described below.

Survey sample

The final sample for this endline survey included 93 treatment markets (out of a total of 109 originally randomized treatment markets) and 83 control markets (out of a total of 109 originally randomized control markets) [10]. Due to time, budgetary, and logistical constraints, the IDinsight team decided to focus on 10 out of the 12 agencies that received phone. We surveyed 1,797 farmers across these 176 markets. Survey respondents were sampled from lists of farmers who received chemicals from JFS during the 2015-2016 planting season.[11]

Administrative data sample

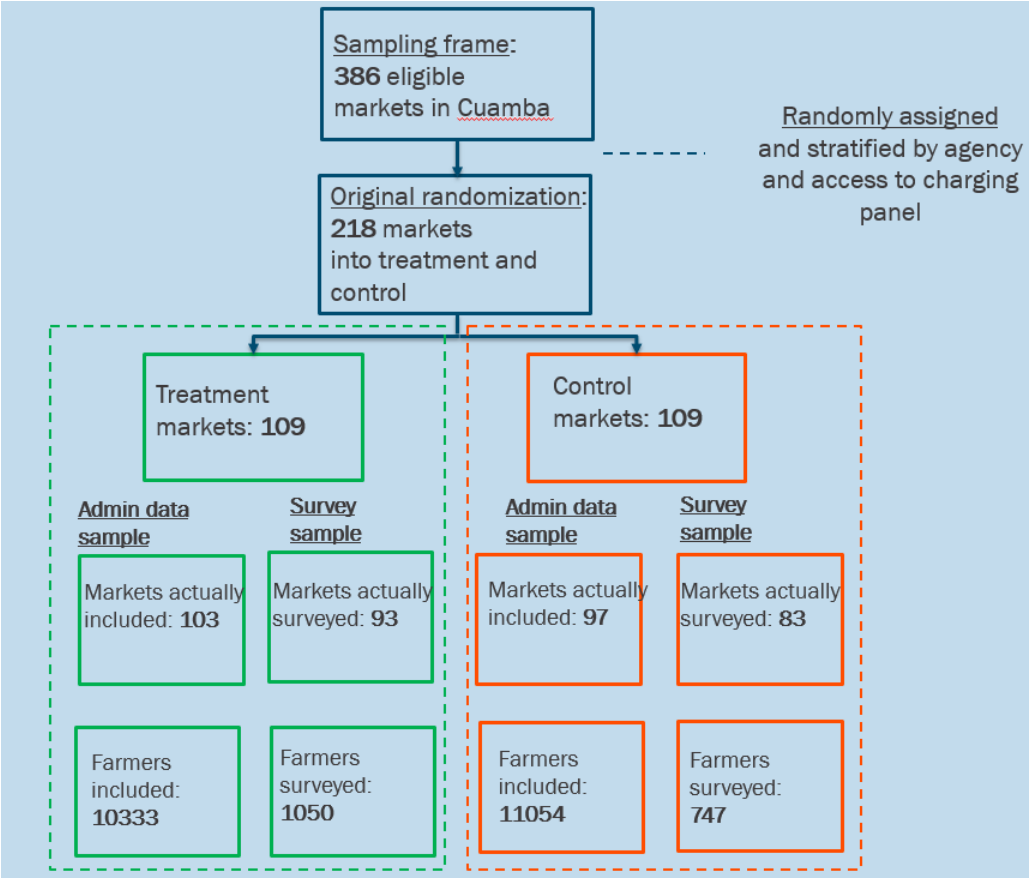
The final sample for this dataset included all farmers that received seeds from JFS in the 2016/17 cotton season is 97(out of the 109 originally randomized control markets) control markets and 103 (out of the 109 originally randomized treatment markets) treatment markets[12]. Note that although these farmers received seeds from JFS, only around 50% went on to actually cultivate and sell cotton to JFS. Not everyone in treatment markets received a phone from JFS, as only farmers who received chemicals from JFS in 2015/2016 were eligible to receive a phone.

[10] We ended up surveying a higher number of treatment markets since the voice vs text pilot was only concentrated to these markets and we needed to visit the 15 markets that were involved in the pilot, even after we had reached a sufficient sample size.

[11] All farmers that purchased chemicals in the 2015/16 planting season were offered phones in the treatment markets. Hence, in order to ensure comparability of the treatment and control arms, we used this sampling frame to randomly select individual farmers for the survey across treatment and control markets.

[12] We were unable to include all the originally randomized markets in the analysis as the market names did not perfectly match between the randomization list and the administrative dataset. JFS administrative data often has different market names from one season to the next, leading to imperfect matches.

Figure 4 :Overview of sampling frame and final study sample



5.2.5 Analysis

Regression analysis for primary and secondary outcomes

For both primary and secondary outcomes, the impact of the intervention was estimated by comparing farmers in our treatment sample to those in the control sample. Regression analysis was carried out on the different outcomes, using the survey and administrative data. This analysis was carried out at the individual and market level. See Appendix A for detailed regression specifications at the market and individual level.

Variables that were expected to be correlated with the outcome variable – also known as covariates - were included in the regression analysis in order to improve the precision of our impact estimates. Covariates included in the regression were age, gender, the total amount of loan taken on chemicals, and the area of land declared at the time of pesticide receipt. The stratification variables - agency and access to a charging panel - were also included in the regression specification (see Appendix B).

5.3 Results

In this section we report the impact estimates and other results most relevant for JFS's decision-making.

Most outcomes are displayed in graphs, which present the average outcomes of the treatment and control groups. The difference in the height of the bars represents the estimated effect of the CSRM program. The black line on the treatment bar, represents the 90% confidence interval of the treatment mean, which represents a reasonable margin of error of the impact estimate.[13] No intersection between this bar and the control mean signifies a statistically significant treatment effect[14], meaning that the likelihood that treatment and control group results for that outcome are different is high. Additionally, statistical significance is also denoted by stars (number depends on level of significance and is explained in graph) next to the treatment mean in the graphs.

All averages and impact estimates presented in these results account for differences in covariates (explained in detail in the regression analysis section). As such, the averages presented here may vary slightly from actual averages of outcomes that do not adjust for differences in covariates. These unadjusted average outcomes are included in the full regression analysis tables in Appendix C.

For different outcomes we report multiple specifications of the analysis. The three main specifications include analysis conducted using individual level administrative data, analysis conducted using market-level administrative data, and analysis conducted using survey data. More details on these datasets are provided in the previous section on sources of data.

5.3.1 Primary outcomes

Cotton Production

Under cotton production, we examined the program's impact on cotton sale, cotton income, and yield.

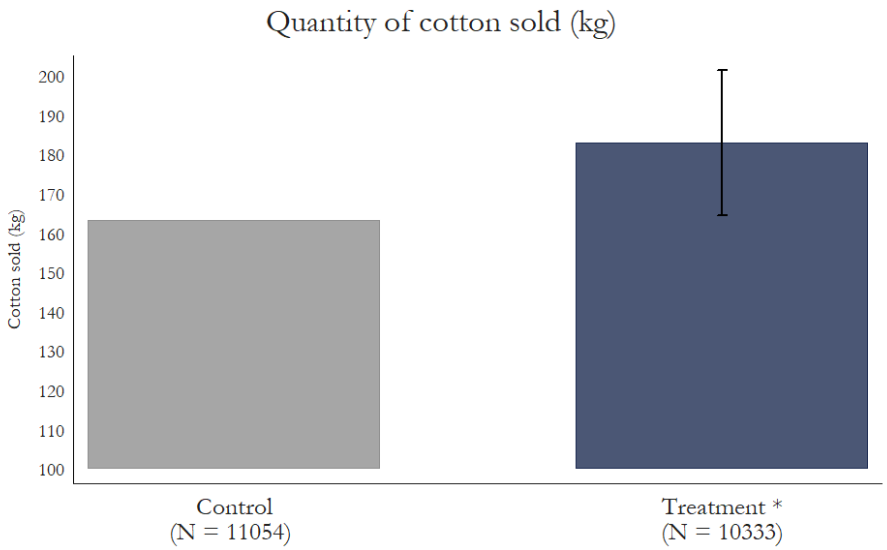
Cotton sale

Farmers in treatment markets sold 12 % (20kg) more cotton on average relative to farmers in control markets. On average, farmers in the treatment markets sold 183 kilograms of cotton compared to the 163 kilograms sold by control farmers. Note that these averages include the roughly 50% of farmers who did not sell cotton at all, meaning that the 12% increase comes from a relatively low base in this sample. Hence, individuals on average ended up selling more cotton to JFS in treatment markets. However, this was driven by a lot more people selling something in the treatment markets as compared to the control markets. Results from the survey data are also consistent with these estimates (see Appendix C for details). However, more farmers (around 80%) in the survey sample sold cotton, so the relative increase in sales is smaller (around 4%) and not significantly different than zero.

[13] The 90% confidence interval means that the true population mean would fall between the bounds of the confidence interval 90% of the time if repeated samples were taken.

[14] A treatment effect is defined as statistically significant when it is unlikely to have occurred as a result of chance. It is important for the implementer to also consider the magnitude of a statistically significant result to gauge efficacy of the program.

Figure 5: Cotton sales

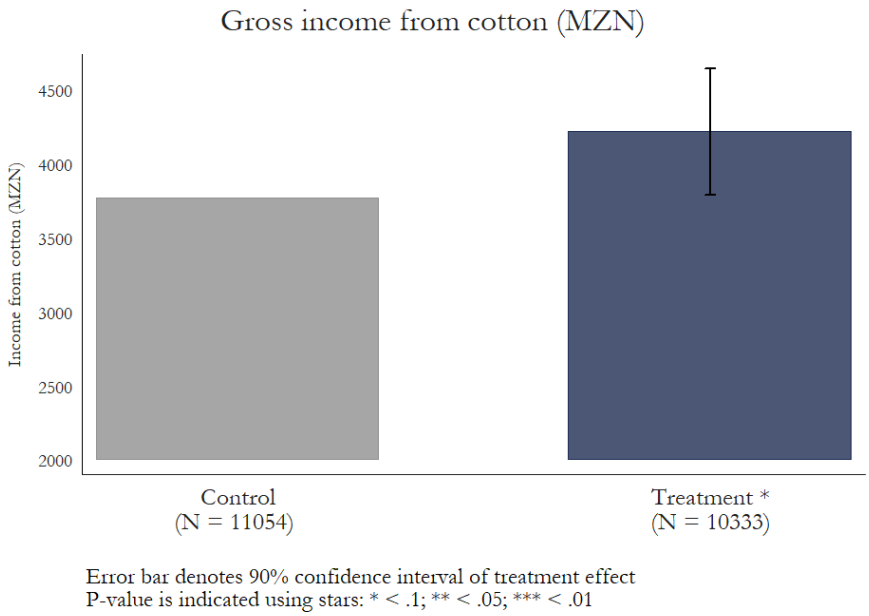


Error bar denotes 90% confidence interval of treatment effect
P-value is indicated using stars: * < .1; ** < .05; *** < .01

Cotton income

Farmers in treatment markets on average earned 12% (451 MZN) more income from cotton than those in control markets. Treatment farmers earned 4224 MZN on average compared to 3773 MZN earned by control farmers. Consequently, farmers in treatment markets had **397 MZN** more net income from cotton on average after they had repaid their loans from JFS compared to those in control markets. Survey results are consistent with results reported in this section (see Appendix C), but as with the sales results the relative increase is smaller and not significant.

Figure 6: Gross income from cotton



It is important to note that our survey was not designed to capture a complete picture of farmer income, so we do not know if increase in cotton income led to higher overall family income.

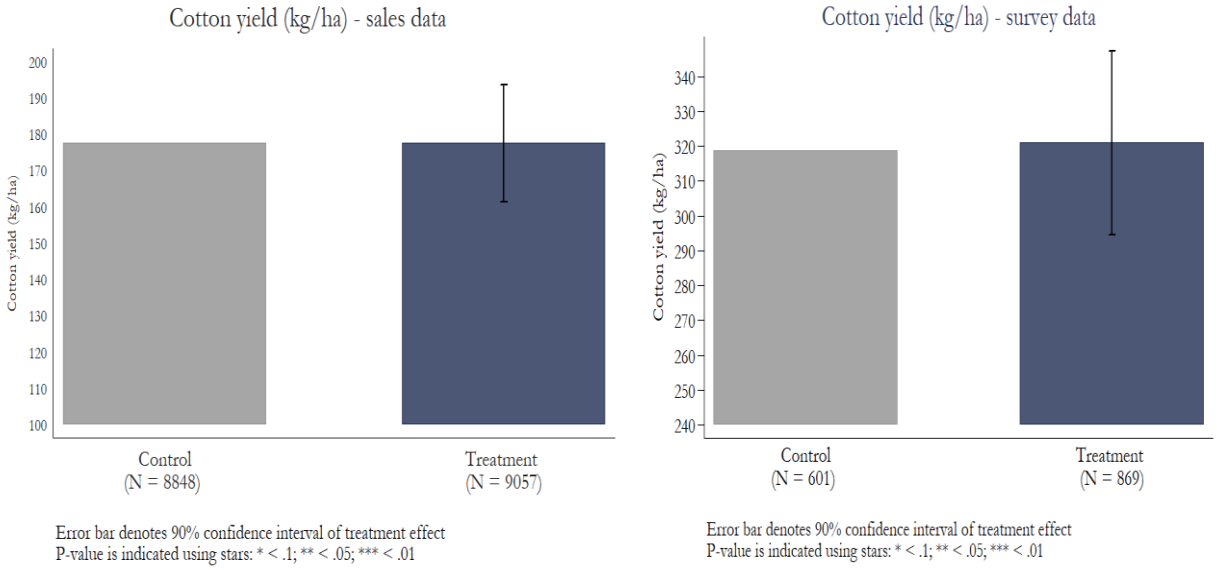
The results on sales and income could have been driven by the program inducing farmers to grow cotton who wouldn't have grown otherwise, inducing farmers to increase area dedicated to cotton, or by causing increased yields. However, in the results that follow, we will show that increased sales appear to be driven entirely by treatment inducing farmers to grow cotton who wouldn't have otherwise.

Cotton yield

There was no significant difference in cotton yield[15] between farmers in treatment and control markets. We analyzed yield for all farmers who took chemicals from JFS, even if they did not continue on to sell cotton to JFS[16]. Results from both, administrative and survey data, indicate that the CSRM treatment had little effect, if any, on cotton yield for this season. However, the measured effect on yield is relatively imprecise, so we are unable to discard the possibility of an effect. We also find no increase in land dedicated to cotton among cotton growers (Appendix C).

[15] For this measure, we used a self-reported estimate of land size provided by farmers to calculate cotton yield.
[16] Farmers who take chemicals are typically expected to grow cotton, however, this is not always the case. In our sample 25% took chemicals but did not go on to plant cotton.

Figure 7: Cotton yield



As seen in Figure 7 above, the average cotton yield is approximately 180 kg in results from the sales data and 320 kg in results from the survey data. We expect this discrepancy to be driven by less precise self-reports of land size in the sales data. These estimates of land size were collected at the time of seed distribution, where farmers are likely to report a higher estimate to get more seed. The land size reported by farmers at the time of survey, is expected to be closer to the truth since they had already planted by this time. The estimated cotton yield measure from the survey data (approximately 320 kg) is also consistent with JFS estimates from other studies. However, despite the differences in reported land size, analysis on both the sales and the survey data show no significant differences in cotton yield between treatment and control markets.

Farmer retention

According to the program theory of change, the program is expected to improve retention due to a feeling of increased loyalty towards JFS. We explore retention from 2 different angles:

1) **Retention from one season to the next:** A farmer who grew cotton in the previous season (2015/16) and continued to grow cotton this season (2016/17). Survey data was used to measure this outcome.[17]

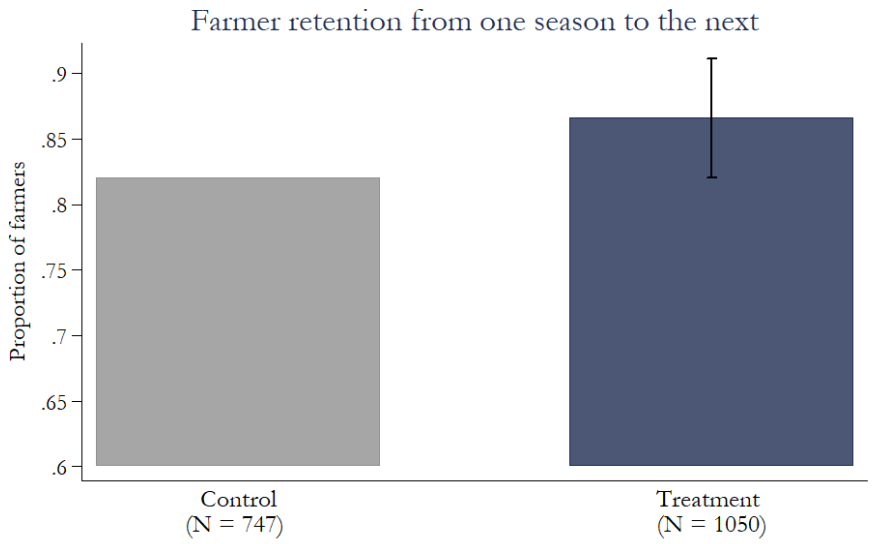
[17] Since our sample of farmers was selected using a sampling frame of farmers that grew cotton in the previous season, farmers that grew cotton this season were "retained" by JFS.

2) **Retention from seed purchase to cotton cultivation:** A farmer who took seeds at the beginning of this season (2016/17) and continued on to plant and harvest cotton.[18] Administrative data was used to measure this outcome.

Retention from one season to the next

Treatment markets saw a modest increase[19] in the number of farmers who grew cotton last season and continued to grow cotton this season in comparison to control markets. Farmers in treatment markets were **4.6 percentage points** more likely to plant cotton this season. On average, 82% of the farmers in control markets who grew cotton last season continued to grow this year compared to 86.6% in treatment markets.

Figure 8: Farmer retention from one season to the next



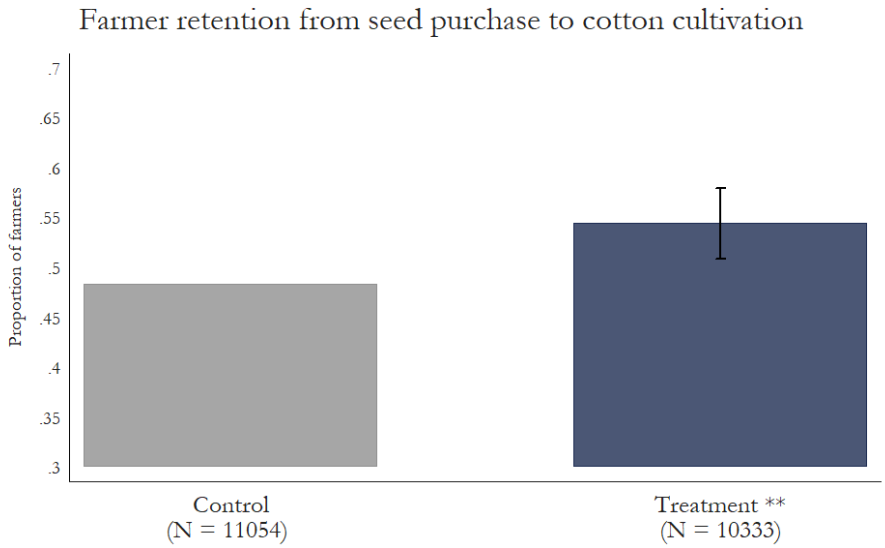
Error bar denotes 90% confidence interval of treatment effect
P-value is indicated using stars: * < .1; ** < .05; *** < .01

Retention from seed purchase to cotton cultivation

The distribution of phones increased the likelihood that farmers who took seeds continued on to actually plant cotton. Among the group of farmers who received seeds in 2016, those from treatment markets were **5.3 percentage points more** likely to plant cotton and sell to JFS than farmers in control markets. On average, 49% of farmers in control markets who took seeds continued to plant cotton compared to 54.3% in treatment markets.

[18] A large percentage (50%) of farmers do not actually plant cotton despite taking cotton seeds (which are distributed for free) from JFS.
[19] Although this result is not statistically significant at conventional levels, the p- value of the result is very close to .01 (if p<.1, impact estimate is within the 90% level of confidence)

Figure 9: Farmer retention from seed purchase to cotton cultivation



Error bar denotes 90% confidence interval of treatment effect
P-value is indicated using stars: * < .1; ** < .05; *** < .01

Further analysis revealed that **about half the effect on retention is driven by people making the choice to grow cotton in the first place[20].** We believe that retention may have worked in two important ways, 1) convincing farmers to grow cotton in the first place, and 2) convincing farmers to sell to JFS (as opposed to not harvesting or side-selling).

5.3.2 Secondary outcomes

Knowledge of Good Agricultural Practices (GAP)

We asked farmers questions on key themes that JFS sends information on in order to assess whether the intervention increased knowledge of GAPs. These questions are presented in Table 5 and were constructed in collaboration with JFS, after comprehensively analyzing the messages sent by JFS.

[20] A regression of treatment on a dummy of people who took credit in 2017 (proxy for making conscious choice to grow cotton) gives us an idea of how the treatment affected people growing cotton (2.4%). The rest of the effect is driven from inducing people who do grow cotton to actually sell. This other part could be a combination of lower crop failure, lower likelihood of leaving cotton in the fields, or reduced side selling. However, given the results on increased loan repayment amongst farmers (section 5.3.2), the effect seems to be driven by reduced side selling.

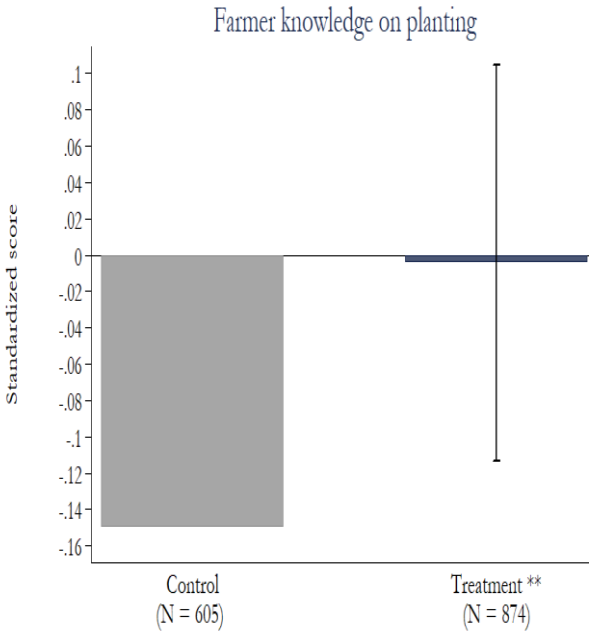
Table 5: Overview of GAP themes included in survey

GAP themes	Questions
Farm preparation	How should you prepare your farm for planting?
Cotton preparation	What is the best way to sow cotton seeds?
Cotton planting	What do you do not to lose your cotton?
Timing of pesticide use	When do you think you should spray pesticides?
Pesticide use protocol	What should you take care of while spraying pesticides?
Timing of harvest	How do you know it is time to harvest?
Benefits of early harvest	Why is it advisable to pick cotton early?
Harvesting	What should you do if the cotton is opening and it is staring to rain?
Cotton drying	How should you harvest and bag the cotton to maintain the quality of the cotton?
Cotton storage	How do you dry your cotton?
Preparation for sale	What do you do when you have cotton ready for the market?

The GAP outcomes depicted in the table above were combined into an index using a standard technique in the evaluation literature (Anderson, 2008). We conducted analysis on separate themes and also on this composite index. Knowledge scores were computed for different themes by counting the number of correct answers given by a farmer out of all possible correct answers.

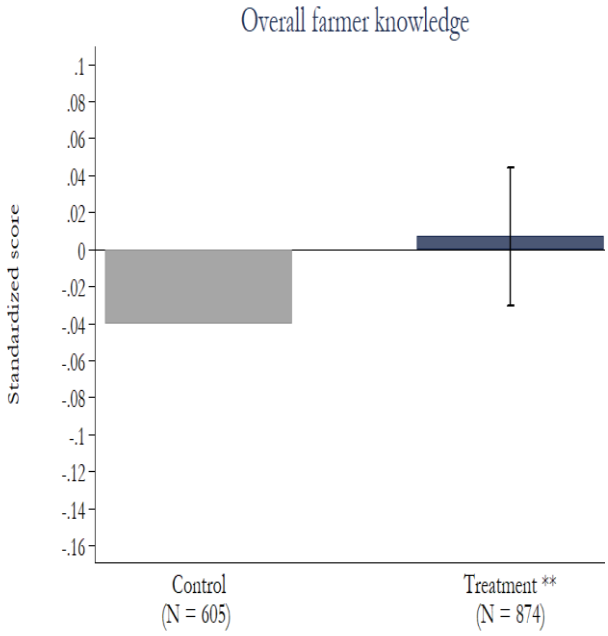
Differences in GAP knowledge scores are expressed as standard effect sizes, calculated as the difference in the number of standard deviations (SD) between the average score of the treatment farmers and the average score of the control farmers. The standard effect size gives a sense of how much knowledge scores differ relative to the spread in scores. In related studies, an effect size of less than 0.1 SD is typically considered small, while an effect size of more than 0.3 SD is considered large, and an effect size of more than 0.5 SD is considered very large (Abdul Latif Jameel Poverty Action Lab (J-PAL), n.d.).

Figure 10a: Farmer knowledge on planting



Error bar denotes 90% confidence interval of treatment effect
P-value is indicated using stars: * < .1; ** < .05; *** < .01

Figure 10b: Overall farmer knowledge



Error bar denotes 90% confidence interval of treatment effect
P-value is indicated using stars: * < .1; ** < .05; *** < .01

Farmers in treatment markets experienced a small increase in overall GAP knowledge compared to the control group, largely driven by a significant increase in knowledge of cotton planting[21]. Overall, treatment farmers scored **0.05 SD higher** on average on the composite index of GAP knowledge compared to those in the control market. This change was statistically significant at the 5% level of significance. We **also looked at each theme individually and identified an insignificant increase for most outcomes**, with a large increase only in the planting theme (which is presumably driving the result for the composite index). Except for the overall composite GAP index score and the planting theme score, no other score was significantly different from zero. The changes in scores for different themes are also presented below:

[21] Both the treatment and control averages for this score are negative. This is because the knowledge score is an index created to have a mean of zero, however, in this regression averages fall below zero due to the application of sampling weights.

Table 6: Overview of GAP knowledge score change

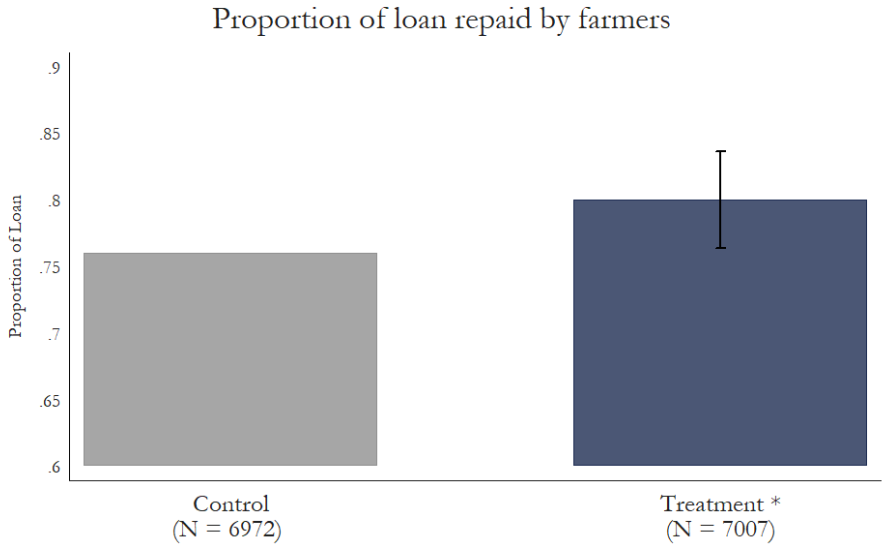
Theme	Average change in knowledge of treatment farmers
Farm preparation	.060 SD
Cotton preparation	.075 SD
Cotton planting	.146 SD**
Timing of pesticide use	.026 SD
Pesticide use protocol	.045 SD
Timing of harvest	.029 SD
Benefits of early harvest	.081 SD
Harvesting	.001 SD
Cotton drying	.012 SD
Cotton storage	.007 SD
Preparation for sale	-.011 SD
Overall Composite Index	.046 SD**

P value indicated using stars: *<.1, **,.05, ***<.01

Loan repayment

The intervention led to a 4% higher loan repayment. On average, farmers in treatment markets repaid 80% of the loans they took from JFS compared to 76% repaid by farmers in control markets.

Figure 11: Proportion of loan repaid by farmers



Error bar denotes 90% confidence interval of treatment effect
P-value is indicated using stars: * < .1; ** < .05; *** < .01

5.3.3 Operational outcomes

In order to gauge effectiveness of implementation for this intervention, we measured important operational outcomes that test critical assumptions in the program ToC. This investigation identified

several operational challenges, addressing which could help further improve final program outcomes. Table 7 summarizes these outcomes and operational challenges, and each outcome is discussed in detail below.

Table 7: Overview of Operational Outcomes and Challenges

	Select assumptions from ToC	Operational outcome measured	Survey Result	Operational challenge identified
1	Farmers retain phones distributed by JFS in working condition	Self- reported phone status	28% did not have operational phones	Phones lost or damaged
2	Farmers receive messages sent by JFS	Self- reported message receipt	24% farmers do not recall receiving messages	Phones out of battery, lack of network in area, use of secondary phones by farmers
		Frequency of message receipt	Only 23% received a message in the last week	Phones not frequently charged
3	Farmers understand messages	Self-reported understanding of message content	20% of the surveyed farmers reported not understanding message content	Message content not understood
		Farmers recall of message content	Farmers recalled 29% of the topics JFS sent messages on	None
4	Farmers use phones to contact JFS	Farmers contact (call or message) JFS	Only 33% report ever contacting JFS using their phone	Lack of call credit, farmers don't know how to contact JFS, farmers contact activista instead of JFS
5	Messages sent by JFS are relevant and useful	Self- reported usefulness of GAP messages	93% are satisfied due to useful and timely messages. Farmers wanted additional information on input distribution	Lack of information on input distribution and usage
6	Farmers are satisfied with service	Self- reported satisfaction	Same as above	None
7	Farmers adopt good agronomy practices	Adoption of GAPs	When JFS tips are different from practice, 44% always adopt tips & 53% sometimes adopt tips	None

Phone Status

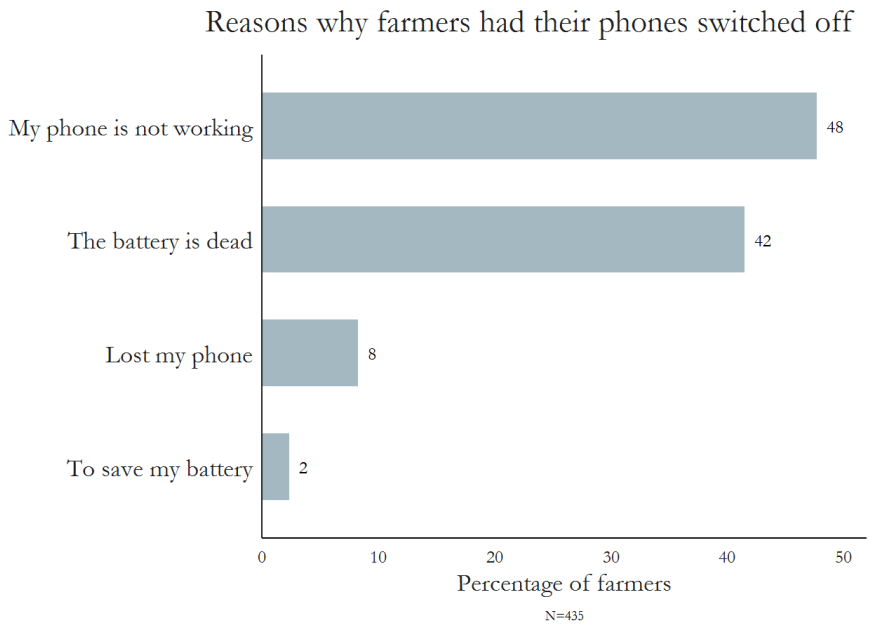
28% of the farmers who received phones from JFS did not have an operational phone at the time of the survey. The most common reasons were damaged or lost phones.

Message receipt

Nearly a quarter of the farmers who received phones do not remember receiving any messages from JFS. Survey results further suggest that this was driven by the following factors:

1. **Damaged phones due to hardware issues**
   44% of the farmers had their phones switched off and 26% did not have their phones with them at the time of survey. Farmers whose phones were switched off reported that the biggest reasons for this were that their phones were either not working (48%), out of battery (42%), or, lost or stolen (8%)

Figure 12: Reasons why farmer phones were switched off



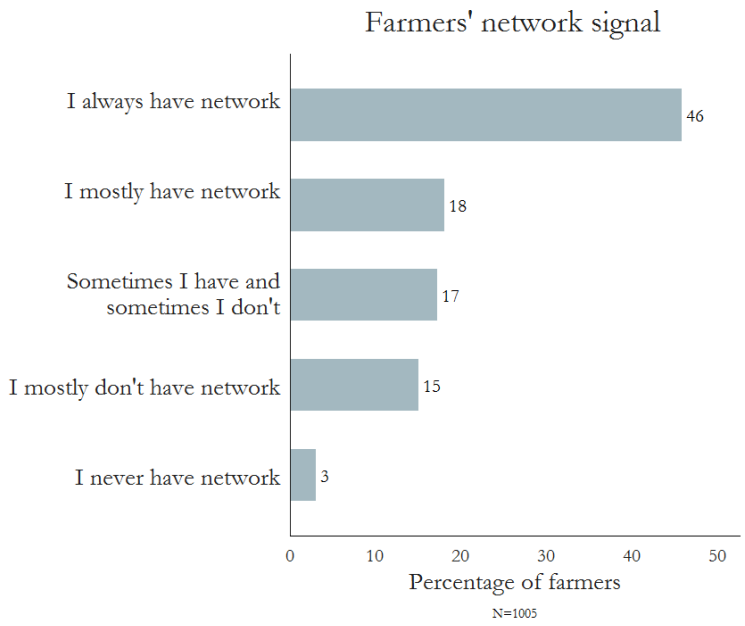
The phone battery dying continues to be a constraint for farmers. Farmers reported a lack of regular and affordable access to charging stations as a major reason for drained batteries. Farmers also report that the solar charging panels that they have access to are meant for larger electronics and often spoil phone batteries as a result.

Interviews with farmers and activistas additionally revealed that phones have been affected by a range of other issues such as broken batteries, LCD, and keypads. Many farmers have had broken phones for several months which affects their usage and interaction with this program.

2. **Farmers opting to use their personal phones more regularly than their JFS phones. 17% of the farmers owned a personal phone and of these, about 70% reported that they used their personal phones more regularly than the JFS phones**. Most (96%) of these farmers also claimed that they kept their personal phones regularly charged. Interviews with farmers and activistas further revealed that farmers may have opted to use personal phones because their JFS phones were damaged or the battery life was longer on the personal phones. Intermittent use of JFS phones can further dilute the efficacy of the program and farmers may miss important messages or not receive them on time.

3. **Limited mobile network coverage in some areas**
Limited network coverage contributed to farmers not receiving messages sent by JFS, especially in 9 markets. [22] In those markets, more than half the farmers reported that they did not have network signal in their area. This may have resulted in farmers either not receiving messages at all or receiving messages late- thereby affecting the efficacy of the intervention in these markets.

Figure 13: Network availability at farmers' homesteads



Frequency of message receipt

Only a quarter of the farmers had received any message from JFS during the past week. If farmers are not receiving these messages frequently, they could be missing out on important information which may not be relevant at a later point in time (e.g. weather forecasts). Operational challenges such as lack of frequently charged phones may be contributing to this.

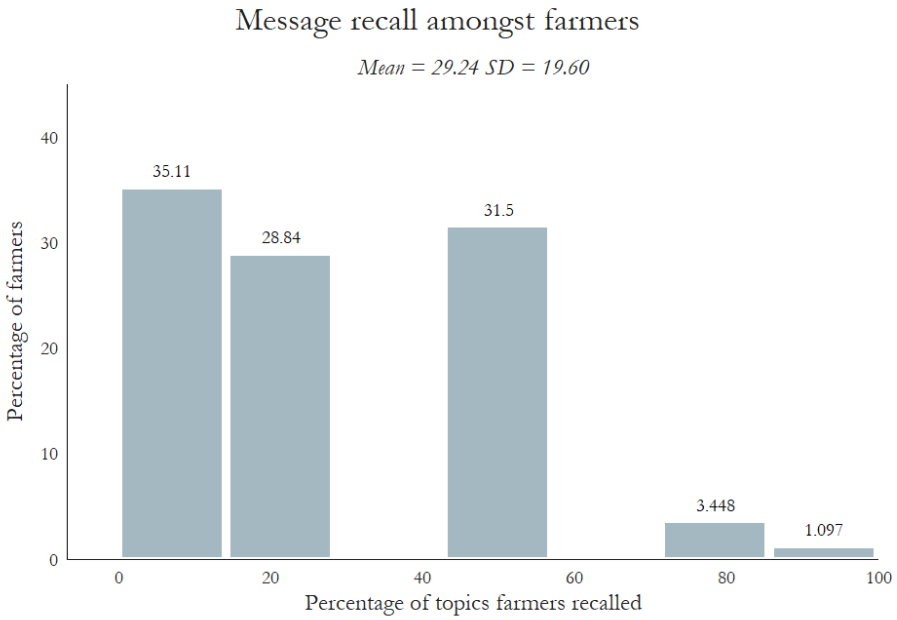
[22] Barragem, Cungune, Horowanha 2, Macaue 1, Moatize 2, Muela, Muita 2, Nairubi and Saruma. We are not aware of any common characteristics amongst these markets.

Understanding and recall of message content

80% of the farmers claimed that they understood the messages sent by JFS. This figure is uncharacteristically high given low literacy levels amongst farmers in this region. Qualitative interviews suggested that if farmers couldn't read themselves, they asked a family member, neighbor, or the activista to translate the messages for them.

In order to further verify farmer understanding and retention of message content, we also asked farmers about the type of information received in the JFS messages. **On average, farmers recalled 29% of the topics that JFS had sent messages on last season** (see Figure 14). This is a low base level of recall, however, this could be attributable to recall bias - farmers may not have remembered all topics at the time of survey. It could also be the case that farmers did not receive the messages frequently and so were unable to recall all the topics.

Figure 14: Message content recall amongst farmers

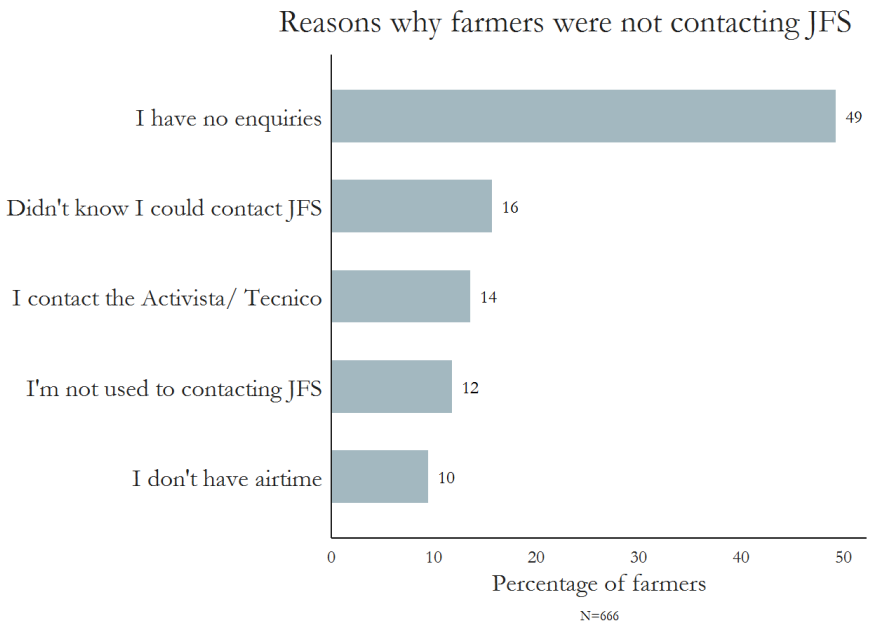


Contacting JFS

Only a third of the farmers that received phones reported having contacted JFS using their phone. The main reasons for not contacting JFS were a lack of queries and not knowing how to contact JFS.

Qualitative interviews revealed that the activista still serves as the main source of information for most farmers. Farmers prefer contacting the activista because they feel more comfortable due to a longer working relationship. Another reason could be that they often meet the activista in person, thereby foregoing expenditure on credit or on charging phones. Given this seemingly close relationship between farmers and activistas, it is important to ensure that activistas have accurate knowledge and information about JFS activities.

Figure 15: Reasons for not contacting JFS



We were unable to verify these results with administrative data from the CSRM database. However, conversations with JFS indicate that their system data estimates lower interaction between the farmers and JFS. This discrepancy could be driven by imprecise recall during survey and farmers' reporting contacting the activista as contacting JFS.

Message relevance and farmer satisfaction

93% of the farmers reported being highly satisfied with the CSRM program because they found the messages useful and timely. 48% indicated that they learned something new from these messages. Qualitative interviews indicated that even though the messages did not necessarily contain new information, they served as a nudge or reminder to farmers to execute important activities.

In addition to current messages, farmers indicated that they would also like to receive information on the distribution of chemicals and seed and the price of cotton before the planting season begins.

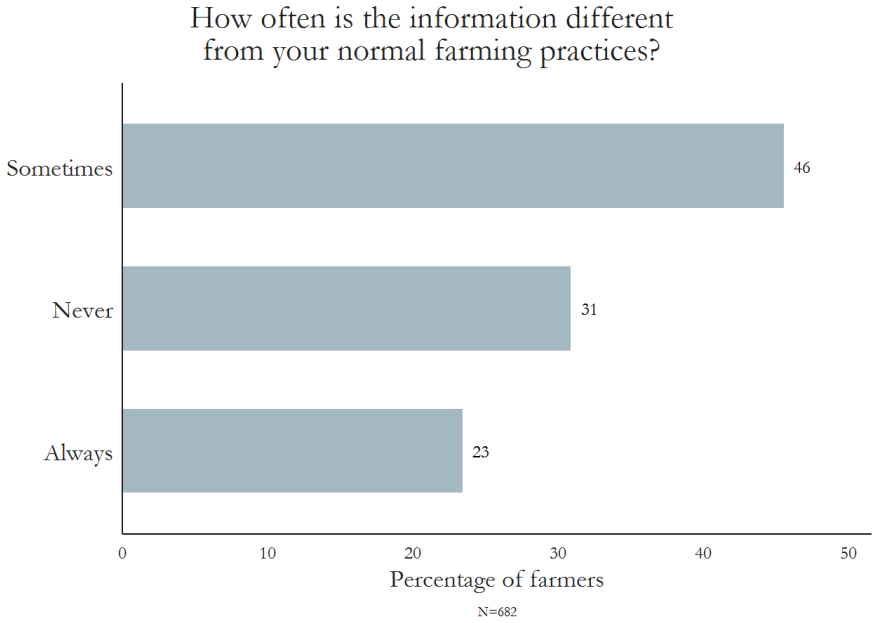
Adoption of GAPs

Nearly a quarter of the farmers reported that the JFS tips were always different from their farming practice. Additionally, another 45% farmers said that the tips sometimes differed from their practice (see Figure 16).

When these tips were different from their practice, 44% of farmers reported <u>always</u> changing their practice to follow JFS advice, and 53% reported <u>sometimes</u> changing their practice. Qualitative interviews with activistas reveal that pesticide use and correct spacing of seeds when planting, were the areas of noticeable change in farmer behavior this season.

The few people who reported never taking JFS advice reported that this was either because they saw the message too late or because they did not understand it.

Figure 16: Differences between JFS tips and farmer practice



5.4 Discussion of results

The CSRM program saw encouraging results in its first year. The intervention significantly increased the quantity of cotton sold, farmer income from cotton, loan repayment rates, and farmer retention. We also saw some increase in knowledge of GAPs amongst farmers in treatment markets.

There is potential for even higher impact with better design and implementation. Results this season were encouraging, yet, program effectiveness was limited by certain operational barriers to implementation such as damaged phones due to hardware issues, limited network coverage in some areas, and farmers opting to use their personal phones as their primary phones. Mitigating these barriers could further strengthen program implementation and improve impact.

In order to understand the specific channels through which final outcomes such as cotton income and sales are impacted, the following channels of impact (as included in the theory of change) were investigated:

1. **Timely provision of key information by SMS or voice and access to trained call centre operators.** These messages are expected to change behaviour for achievement of basic best practices, leading to higher cotton yields in treatment markets. Additionally, the call centre is expected to improve communication between farmers and JFS and provide individualized support to farmers to encourage adoption of best practices and consequently lead to improved yields.

2. **Loyalty from receiving a mobile phone**: Receiving a phone is expected to improve farmer retention due to increased satisfaction towards JFS and the development of a sense of loyalty.

Data indicates that the improvements in outcomes this season largely stem from increased retention due to increased loyalty towards JFS from receiving a mobile phone. Cotton farmers in the treatment markets did not sell a higher quantity of cotton on average, however, **there were more farmers that sold cotton in these treatment markets**. JFS distributed phones at the time of distribution of cotton seeds, which may have encouraged more farmers in these markets to continue on to plant cotton. This distribution might have triggered a feeling of motivation or satisfaction amongst farmers, leading to a sense of increased loyalty towards JFS and nudging them towards planting this season (and not side-selling). It is also possible that receiving phones and learning about the intervention led to expectations of higher yields (e.g. they may have expected more support in the event of a pest attack or abnormal weather) amongst farmers, making them more likely to plant cotton.

It is unclear if the phones themselves or the SMS messages led to increased retention. The experiment was not designed to causally infer whether it was the reception of SMS messages or the phone driving retention as everyone who received phones was also sent text messages. We conducted some exploratory heterogeneity analysis to understand if there was greater retention for people living in areas where they were more likely to receive the messages (due to phones being operational). We did not find evidence that these places had higher retention, though the findings are not conclusive.[23]

We also observed a higher rate of loan repayment amongst treatment farmers. One expected channel of impact here would be higher loan repayments driven by increased farmer incomes. However, this is unlikely since we did not see increases in cotton yields. Instead, we believe that an increased sense of loyalty towards JFS compelled farmers to sell to them instead of side-selling amongst each other, leading to lower instances of defaulting on loans.

The small increase in knowledge on planting amongst treatment farmers did not translate into improved cotton yields. This makes it unlikely that the impact on sales was through the reception of information via SMSs this season. However, the lack of higher average yields in treatment markets this season doesn't mean that CSRM is ineffective at improving yields. In future seasons, the increase in knowledge on planting may translate into higher yields. Furthermore, with abnormal weather or pest conditions, the phones may be instrumental in increasing yields.

Lastly, qualitative work by IDinsight also indicated that the **two-way communication between extension officers and farmers has created a more efficient extension system for JFS.** Benefits include (1) more effective input distribution to farmers, (2) faster farmer mobilization for meetings,

[23] We looked for differential effects in areas with more vs less access to charging, and also looking at places where farmers were more vs less likely to have their phone turned on during our survey. We did not find differential effects in these subgroups.

(3) improved ability for farmers to ask questions directly to their extension officers, and (4) increased reporting of "activista"-level corruption to extension officers.

The intervention has improved important cotton production outcomes for JFS in the current season but the longer-term effects needs to be explored. Theoretically, there are ambiguous effects of the CSRM intervention in the future. On the one hand, it could be that the sense of loyalty towards JFS decreases over subsequent seasons as the novelty of receiving the phones wears off. In contrast, it is also possible that the knowledge of GAPs accrues over seasons to result in improved yields. Thus, to completely assess CSRM's impact, future research should focus on the following questions:

1) Are the improvements in cotton sale and income due to increased retention sustained over seasons?
2) Does increase in GAP knowledge lead to changes in cotton yield over multiple seasons?
3) Does overall farmer welfare (including income from other sources) improve as a result of this intervention?

5.5 Recommendations

This section presents cost effective suggestions for JFS to improve program design, implementation, and monitoring to achieve better outcomes in the coming years. The recommendations draw findings from the impact results, qualitative interviews, and IDinsight observations during fieldwork.

IDinsight recommends JFS i) continue the CRSM program, ii) make adjustments to design and implementation, and iii) conduct a low-cost evaluation of program impact in the present season.

Key recommendations to improve program effectiveness include:

Program design and implementation

a. **Add the farmers' personal phone numbers to the CSRM database** and send messages to these numbers as well. This could improve reach at marginal cost to JFS.
    - 17% of the farmers owned a personal phone and 70% reported using this more regularly. Sending messages to personal numbers can increase the likelihood of farmers receiving and reading the message.

b. **Evaluate the effectiveness of the solar panels distributed in the pilot and consider distributing solar panels to activistas in more markets.**
    - 40% of the farmers who had their phones switched off at the time of the survey reported it was due to lack of battery. Qualitative interviews revealed that access to charging panels was low and expensive.
    - JSF is aware of this challenge and distributed solar panels in 12 markets that were far from a power source. Assessing the cost effectiveness of these panels and considering distribution of panels to activistas could mitigate charging related constraints

c. **Provide adequate support for the activistas.** Make sure that activistas have working mobile phones, they are sufficiently trained on how to use phones, and they receive their monthly allowance on time.
    - Qualitative interviews revealed that activistas are the main source of information and the first point of contact for farmers. It is hence important to support them such that they can adequately assist farmers.

d. **Redistribute the stickers with the JFS call center number for farmers to stick at the back of their phones.**
    - 12% of farmers (who hadn't contacted JFS) reported that they hadn't done so because they did not know that they could contact them directly
    - The stickers can help increase awareness about the call center and can also serve as a useful reminder of the JFS contact number

e. **Send specific, detailed information in messages.** Farmers are likely to benefit most from targeted messages that provide all relevant details.

    a) **Notify farmers about input distribution and usage** by sending multiple messages in the week leading up to these events with important details included. JFS could consider sending messages by market, based on where they are distributing to ensure farmers receive accurate information.
        - 30% of farmers suggested that the timing of seeds and chemical distribution should be included in message content
        - Qualitative interviews also revealed that farmers were often using pesticides incorrectly or at the wrong time.
    b) **Consider re-evaluating content of current messages to ensure sufficient details are included.** JFS could also consider running small focus groups with farmers to assess their satisfaction with content of specific messages and suggestions for additional information to add.

Monitoring and Evaluation

a. **Strengthen internal data collection systems.** JFS is currently rebuilding its database to ensure that they have up-to-date information on farmers, credit taken, and cotton in one place. The new database is automated and well-built. JFS could consider the following to strengthen it further:
    - Ensure that farmer information in all the different datasets is always connected to the producer reference number. This is critical to track performance across seasons.
    - Market names change across the different databases, making it difficult to match markets across these different datasets. For all future data collection, JFS should consider pre-filling information such as market name, agency name, and tecnico name in the excel sheet. This ensures that the person entering the data can select these details, thereby reducing spelling or typing errors.

- Similarly, for columns in which data regarding sales, credit etc. is being recorded – JFS can restrict entries to numerical only to ensure units etc. are not added into the incorrect column

b. **Explore conducting an inexpensive impact evaluation of program impact on present season using administrative data.** It is important to understand if short term effects observed in this evaluation are sustainable over multiple seasons.
    - JFS can conduct an evaluation at relatively low cost as it has an existing administrative database which records all relevant information.
    - Another evaluation would require limited scale-up of this intervention in order to maintain an appropriate comparison group of farmers. If JFS does want to distribute additional phones without compromising the comparison group they could consider randomly distributing new phones to some farmers in control markets. IDinsight can provide targeted technical support to design the evaluation if JFS pursues this option.

6. Evaluation 2- Voice vs text pilot

6.1 Evaluation methodology

6.1.1 Research questions and outcomes

The main objective of this pilot-evaluation was to allow JFS to choose the optimal way to communicate with farmers and encourage farmer action- via text or voice messages. This evaluation focused on operational outcomes, comparing these outcomes between farmers who received voice messages and farmers who received text messages. Table 8 outlines the outcomes and their respective indicators.

Table 8: Outcomes and indicators for the voice and text pilot-evaluation

Outcomes	Indicators
Message response	• Proportion of farmers that contacted JFS
Message receipt	• Proportion of farmers who recalled receiving messages from JFS
Message recall	• Total number of topics that farmers recalled receiving messages about (out of all possible topics)

6.1.2 Study design

This pilot evaluation was designed as an **individual randomized study**. The pilot was implemented in 15 markets due to operational constraints and high cost of implementing voice messages. Overall farmers in each market were divided into the following 2 evaluation arms.

1. **Voice Message Arm**: 50% of the farmers in a market received voice messages.
2. **Text Message Arm**: 50% of the farmers in a market received text messages.

The goal was to measure the true impact of receiving voice messages by comparing the outcomes of farmers receiving voice messages to those receiving text messages. The unit of analysis was the individual farmer.

6.1.3 Data sources

We used one main sources of primary data:

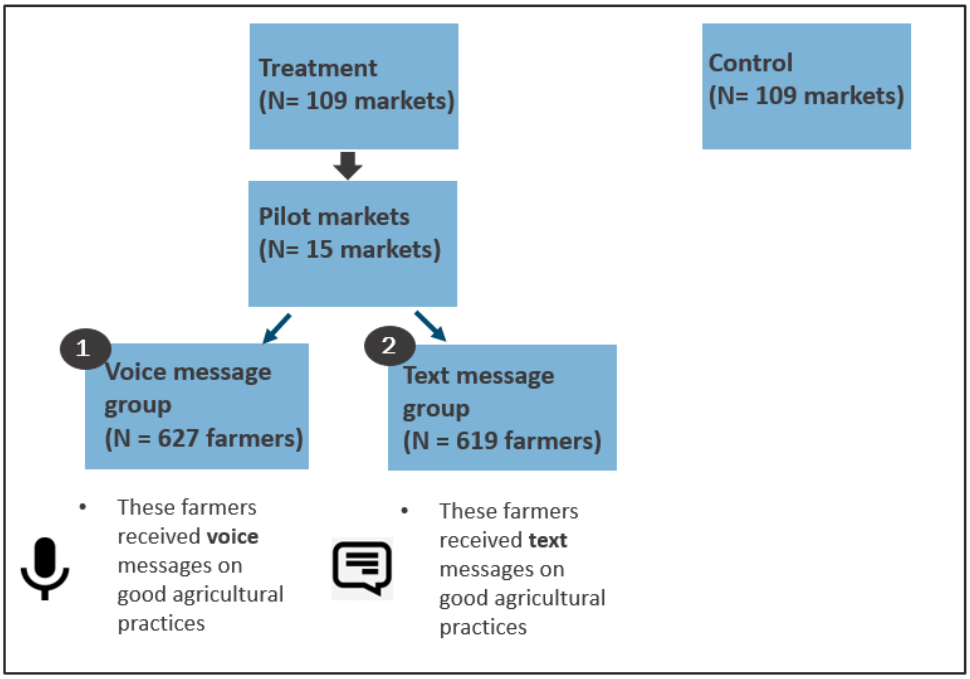
1. **JFS farmer survey**: The survey was administered to a randomly selected sub-sample of farmers that received each type of message in the pilot markets. Survey contents are described in Table 4 in the previous section.

6.1.4 Study sample

Sampling frame: 15 pilot markets were randomly selected from the 109 treatment markets that received phones from JFS. The sampling frame of farmers was the group of farmers that received voice (627) and text (619) messages in these pilot markets. There was some overlap between the sampling frame of treatment markets for the pilot and large-scale evaluations.

Arm assignment: Farmers in these markets were randomly assigned into the voice message and text message arms defined above. Randomization was conducted at the individual level.

Figure 17: Sampling frame for voice vs text pilot study



Study sample: The final study sample comprised of 421 farmers, with 222 text message recipients and 199 voice message recipients. The decision to survey a small subset of all possible farmers in the pilot sampling frame was made by balancing budgetary and statistical power related concerns.

6.1.5 Analysis

Similar to the large-scale evaluation, regression analysis was carried out on the different outcomes, using survey data. This analysis was carried out at the individual level. See Appendix A for detailed regression specifications.

Variables (covariates) that were expected to be correlated with the outcome variable were included in the regression analysis in order to improve the precision of our impact estimates. Covariates included in the regression were age, gender, the total amount of loan taken on chemicals, and the area of land declared at the time of pesticide receipt. The stratification variables – agency and access to charging – were also included in the regression specification.

6.2 Results

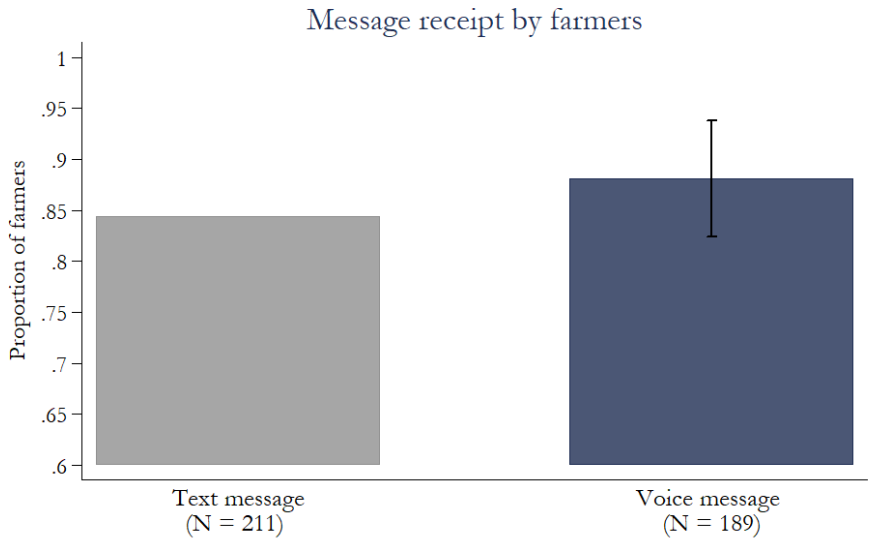
In this section we report the impact estimates from this pilot study that are most relevant for JFS's decision-making.

Results are presented similarly to results in the large-scale evaluation section. All averages and impact estimates in these results also account for differences in covariates. The full regression analysis table data can be found in Appendix C.

Message receipt

There was no significant difference in the rate of self-reported message receipt between voice and text message recipients. On average, around 88% of the farmers who were expected to receive voice messages actually received them compared to 84% of voice message recipients. However, this difference was not statistically significant. These results are surprising as JFS reports that less than 20%[24] of the farmers they try to reach via voice messages, actually receive their messages. However, **it is possible that the surveyed farmers received the same voice messages multiple times.**

Figure 11: Message received by farmers



Error bar denotes 90% confidence interval of treatment effect
P-value is indicated using stars: * < .1; ** < .05; *** < .01

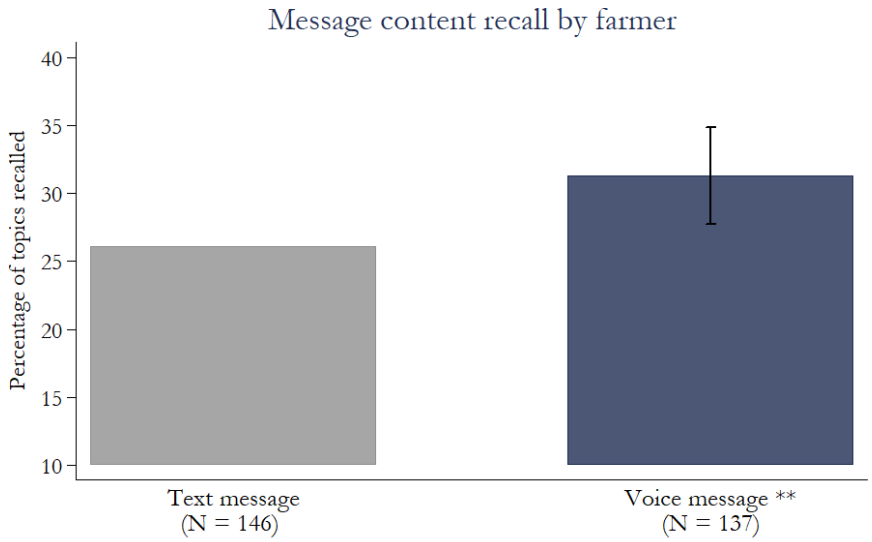
Message recall

We asked farmers to describe the different topics on which they had received information from JFS. Message recall was defined as the number of topics the farmer remembered from a list of all topics that JFS sends information on.

Farmers who received voice messages recalled 5% more message content relative to farmers who received text messages. On average, voice message recipients recalled 31% of the information in messages compared to 26% by text message recipients. This difference in recall could be driven by difference in understanding of message content. Voice messages might be more widely understood by farmers due to lower literacy rates amongst this demographic, leading to higher recall of message content.

[24] This information was provided by JFS CSRM project manager Catija Ali based on internal analytics performed using the CSRM database

Figure 18: Message content recall by farmer

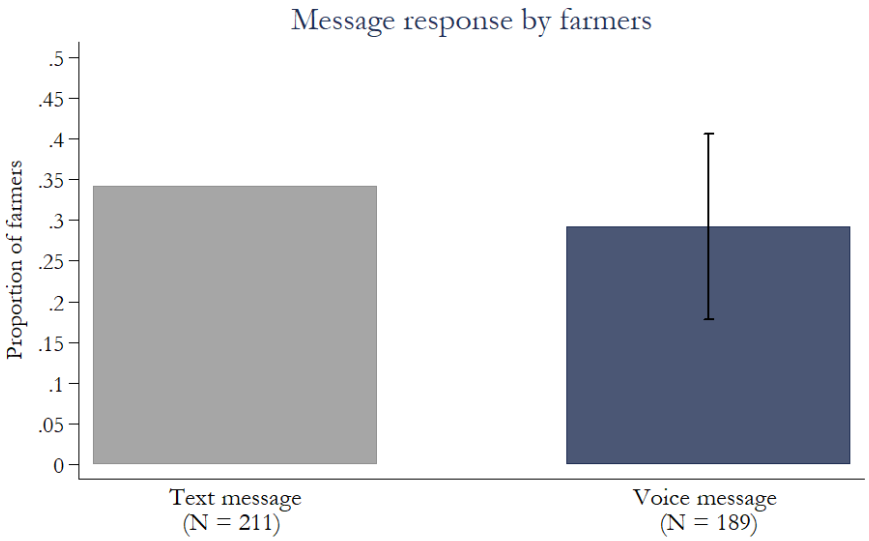


Error bar denotes 90% confidence interval of treatment effect
P-value is indicated using stars: * < .1; ** < .05; *** < .01

Message response

There was no significant difference in the rate of contacting JFS between voice and text message recipients. The rate of contacting JFS was 29% amongst voice message recipients and 34% amongst text message recipients, however, this difference was not statistically significant. It is important to note that the average rate of contacting JFS was low across all farmers, irrespective of the type of messages they received. The operational outcomes section discusses possible reasons for this low response rate and the recommendations section proposes possible solutions.

Figure 19: Message response by farmers



Error bar denotes 90% confidence interval of treatment effect
P-value is indicated using stars: * < .1; ** < .05; *** < .01

Service cost

JFS currently spends nearly 2.5 times more per month on voice messages relative to text messages. Voice messages cost $2500/ month compared to $982[25] / month for text messages. This analysis is based on the assumption that all personnel and equipment expenditure for voice and text messages are equal, with the service provider costs being the only differentiating factor. Cost estimates were provided by JFS project manager Catija Ali and accountant Luis Rodrigues.

6.3 Discussion of results and recommendation

Farmers receiving voice messages recalled significantly more message content relative to text message recipients. This could be driven by the low literacy levels[26] in this region. Farmers receiving voice messages may understand the content better and hence recall more topics. There was no significant difference between voice and text message recipients in terms of message receipt or rate of contacting JFS.

From an operational perspective, voice messages are significantly more expensive than text messages and currently have only a 20% penetration rate, i.e., only 20% of the farmers JFS tries to reach actually receive the voice message. Penetration is likely low because voice messages are difficult to deliver as they need to be received by respondents (like a phone call) and cannot be delivered if the phones are switched off or network is disrupted. The low reach of voice messages could partially be attributable

[25] 1 USD= 60MZN, exchange on www.xe.com, retrieved on 29th January 2018.
[26] The survey data shows that 25% of farmers had no schooling and 29% had basic education (up to Grade 3).

to operational challenges faced this season such as lack of frequently charges phones or lack of network in certain areas. Mitigating some of these challenges could lead to improved reach.

We recommend that JFS carefully weigh the pros and cons of this service before exploring adoption. Voice messages can be a powerful tool, especially if operational barriers are overcome. It is important for JFS to carefully consider a) the importance of increased recall in meeting their objectives and b) the high cost and low current penetration of market of this service, before reaching a decision.

7. References

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Appendix A: Analysis

Analysis for the large-scale impact evaluation

Framework 1: Individual-level analysis

The regressions specifications for this analysis are defined below:

$$Y_{ij} = \beta_0 + \beta_1 * treat_j + \beta_2 * Ypre_{ij} + \beta_3 * X + \beta_4 * pre_{miss} + \beta_5 * cov_{miss} + \varepsilon,$$

The variables are defined as follows:

- Y_{ij}: This is the dependent variable, measured for individual *i* in market *j*. This includes all outcomes mentioned in Table 1 above
- $treat_j$: This is a dummy that takes the value of 1 for participants in a treatment market
- $Ypre_{ij}$: This is the value of the dependent variable pre-intervention. Since we did not conduct a baseline survey, this data came from administrative data, and was only available for certain outcomes.
- pre_{miss}: This is a dummy that takes the value of 1 if pre-intervention data for the dependent variable is not available for this observation. This is only included for variables in which $Ypre_{ij}$ is included in the regression.
- *X*: Is a vector of additional controls. This includes a series of dummies that define the stratification groups, as well as four other variables. The additional controls are area for planting cotton declared at time of pesticide receipt, and the amount of loan taken for chemicals (a separate control for different types of chemicals), age, and gender of farmer.
- cov_{miss}: This is a dummy that takes the value of 1 if covariate data is unavailable for this observation.
- ε_{ij}: This is an error term, assumed to be correlated within markets. We will cluster by market to correct for this.

The sample for the individual-level regressions will consist of the sample of individuals who received the endline survey and farmers included in the individual-level administrative dataset.

Framework 2: Market-level analysis

The regressions specification for the market-level analysis is very similar to the individual-level specification:

$$Y_j = \beta_0 + \beta_1 * treat_j + \beta_2 * Ypre_j + \beta_3 * X + \beta_4 * pre_{miss} + \beta_5 * cov_{miss} + \varepsilon_j,$$

All variables in this specification are defined similarly to the individual- level specification above. The primary difference is that the X vector does not include the additional individual-level covariates. As above, for some variables pre-intervention data is not available.

Analysis for the voice and text pilot evaluation

$$Y_i = \beta_0 + \beta_1 * treat\_voice_i + \beta_3 * X + \varepsilon_i$$

The variables are defined as follows:

Y_i: This is the outcome of interest for individual i

$treat\_voice_i$: This is a dummy that takes the value of 1 for participants that received voice messages

X: This is a vector of dummies including fixed effects for each market as well as controls for the famer's age and gender

Appendix B: Information on covariates

Covariate	Type	Description
Age	Continuous	Self- reported age of the farmer
Gender	Binary	Enumerator observation of the farmer's gender
The total amount of loan taken on chemicals	Continuous	The total amount of loan owed by the farmer, as recorded in the administrative data
The area of land declared at the time of pesticide receipt	Continuous	Self-reported area of land declared by the farmer at the time of pesticide receipt
Agency	Discrete	Administrative unit composed of multiple markets. This was a stratification variable during randomization
Access to charging	Binary	Defined as access to charging panel < 60-minute walk away. This was a stratification variable during randomization

Appendix C: Full regression results

1. Individual-level sales data

VARIABLES	Total quantity of cotton sold (KG)by farmer	Total quantity of cotton sold (KG)by farmer	Total gross income received by farmer (MZN)	Total gross income received by farmer (MZN)	Total net income of farmer after loan repayment (MZN)	Total net income of farmer after loan repayment t (MZN)	=1(if sold any cotton)	=1(if sold any cotton)	Yield (Kg/Ha)	Yield (Kg/Ha)	Area declared by farmer at time of seed distribution- 2016/17	Area declared by farmer at time of seed distribution- 2016/17
Original treatment assignment	21.712*	19.792*	498.425*	451.299*	435.415*	396.562	0.070***	0.060***	3.166	0.003	0.079*	0.081**
	(11.748)	(11.269)	(271.564)	(260.444)	(250.004)	(242.245)	(0.024)	(0.021)	(9.912)	(9.758)	(0.043)	(0.032)
Observations	21,387	21,387	21,387	21,387	21,386	21,386	21,387	21,387	17,905	17,905	21,387	21,387
Adjusted R-squared	0.001	0.007	0.001	0.007	0.001	0.006	0.005	0.022	-0.000	0.008	0.003	0.046
Control mean	163.31	163.31	3773.19	3773.19	3265.70	3265.70	0.48	0.48	177.54	177.54	0.92	0.92
Covariates	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1
All regressions are OLS. Standard errors in parentheses and are clustered at the market level.
Covariates include stratification variables i.e. dummy representing good access to charging; and Agency level fixed effects.

2. Individual-level loan information

VARIABLES	=1 if farmer has fully repaid their debt	=1 if farmer has fully repaid their debt	=1 if farmer has repaid even part of the loan	=1 if farmer has repaid even part of the loan	Proportion of original loan repaid by farmer	Proportion of original loan repaid by farmer
Original treatment assignment	0.045*	0.038*	0.050**	0.041*	0.048**	0.040*
	(0.024)	(0.022)	(0.025)	(0.022)	(0.025)	(0.022)
Observations	13,980	13,980	13,980	13,980	13,979	13,979
Adjusted R-squared	0.003	0.025	0.004	0.030	0.003	0.029
Control mean	0.75	0.75	0.77	0.77	0.76	0.76
Covariates	No	Yes	No	Yes	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1
All regressions are OLS. Standard errors in parentheses and are clustered at the market level.
Covariates include stratification variables i.e. dummy representing good access to charging;
and Agency level fixed effects.

3. Market-level totals

VARIABLES	Total cotton sold (Kg)	Total cotton sold (Kg)	Total no of sellers	Total no of sellers	Total gross income from cotton sold (MZN)	Total gross income from cotton sold (MZN)	Total net income from cotton sold (MZN)	Total net income from cotton sold (MZN)
Original treatment assignment	-49.04	723.28	0.41	2.32	-1,458.09	17,504.81	-824.16	17,363.62
	(2,194.10)	(1,426.17)	(5.52)	(3.76)	(50,740.78)	(33,025.63)	(45,107.34)	(29,700.03)
Total cotton sold (Kg)- 2015/16		0.77***						
		(0.12)						
Total no of sellers - 2015/16				0.61***				
				(0.11)				
Total gross income from cotton sold (thousand MZN)- 2015/16						1.18***		
						(0.18)		
Total net income from cotton sold (thousand MZN) - 2015/16								1.17***
								(0.18)
Observations	200	200	200	200	200	200	200	200
Adjusted R-squared	-0.01	0.65	-0.01	0.64	-0.01	0.65	-0.01	0.63
Control mean	18610	18610	55	55	429989	429989	372122	372122
Covariates	No	Yes	No	Yes	No	Yes	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1

All regressions are OLS. Robust standard errors in parentheses.

Covariates are market level totals of - loan taken for chemicals BIOMITRID, TOP10, K6%, and PRO 64.8%;
and area for planting cotton that the farmer declared at the time of pesticide receipt.

Additional covariates include stratification variables. i.e., dummy representing good access to charging;
and Agency level fixed effects.

Covariates are replaced with zero when missing, accompanied by a dummy for missingness.

4. Market-level loan information

VARIABLES	Total number of farmers that fully repaid loans	Total number of farmers that fully repaid loans	Total number of farmers that paid any part of their loan	Total number of farmers that paid any part of their loan	Total proportion of loan repaid in the market	Total proportion of loan repaid in the market
Original treatment assignment	0.19	2.01	0.41	2.32	0.03	0.03
	(5.39)	(3.69)	(5.52)	(3.76)	(0.02)	(0.02)
Total number of farmers that fully repaid loans - 2015/16		0.62***				
		(0.11)				
Total number of farmers that paid any part of their loan - 2015/16				0.61***		
				(0.11)		
total_loanpaid_proportion_lag						0.00**
						(0.00)
Observations	200	200	200	200	199	199
Adjusted R-squared	-0.01	0.63	-0.01	0.64	0.01	0.17
Control mean	53.76	53.76	55.11	55.11	0.80	0.80
Covariates	No	Yes	No	Yes	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1

All regressions are OLS. Robust standard errors in parentheses.

Covariates are market level totals of - loan taken for chemicals BIOMITRID, TOP10, K6%, and PRO 64.8%; and area for planting cotton that the farmer declared at the time of pesticide receipt.

Additional covariates include stratification variables. i.e. dummy representing good access to charging;

5a. Survey results I

VARIABLES	Cotton sold (Kg)	Cotton sold (Kg)	Cotton sold (Kg)	Cotton sold (Kg)	Total income from cotton sold (MZN)	Total income from cotton sold (MZN)	Total income from cotton sold (MZN)	Total income from cotton sold (MZN)	Cotton yield: cotton produced per hectare	Cotton yield: cotton produced per hectare	Cotton yield: cotton produced per hectare	Cotton yield: cotton produced per hectare
Original treatment status of markets as per randomization	21.490	26.759	9.599	18.999	436.020	625.177	182.905	418.707	-1.985	-2.117	-3.679	2.284
	(28.752)	(33.524)	(24.469)	(31.261)	(678.592)	(788.929)	(570.466)	(727.435)	(15.745)	(19.981)	(14.153)	(16.040)
Observations	1,797	1,797	1,797	1,797	1,797	1,797	1,797	1,797	1,470	1,470	1,470	1,470
Adjusted R-squared	-0.000	0.000	0.129	0.123	-0.000	0.000	0.140	0.139	-0.001	-0.001	0.045	0.063
Control mean	354.14	371.89	354.14	371.89	7653.95	8105.88	7653.95	8105.88	320.07	318.72	320.07	318.72
Covariates	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Sampling weights	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1

All regressions are OLS. Standard errors in parentheses and are clustered at the market level.

Covariates are farmer's age and gender; the amount of loan taken for chemicals BIOMITRID, TOP10, K6%, and PRO 64.8%;

and area for planting cotton that the farmer declared at the time of pesticide receipt; stratifiers (agency fixed effects and good access to charging station).

Covariates are replaced with zero when missing, accompanied by dummies for missingness.

5b. Survey results II

VARIABLES	How much land did you use to grow cotton (in acres) this season?	How much land did you use to grow cotton (in acres) this season?	How much land did you use to grow cotton (in acres) this season?	How much land did you use to grow cotton (in acres) this season?	Retention (=1 if farmer grew cotton in the season of 16/17)	Retention (=1 if farmer grew cotton in the season of 16/17)	Retention (=1 if farmer grew cotton in the season of 16/17)	Retention (=1 if farmer grew cotton in the season of 16/17)
Original treatment status of markets as per randomization	-0.022	-0.042	-0.034	-0.073	0.022	0.050*	0.022	0.046*
	(0.071)	(0.075)	(0.062)	(0.062)	(0.029)	(0.030)	(0.025)	(0.028)
Observations								
Adjusted R-squared	1,470	1,470	1,470	1,470	1,797	1,797	1,797	1,797
Control mean	-0.001	-0.000	0.149	0.168	0.000	0.004	0.044	0.056
Covariates	1.41	1.44	1.41	1.44	0.81	0.82	0.81	0.82
Sampling weights	No	No	Yes	Yes	No	No	Yes	Yes
	No	Yes	No	Yes	No	Yes	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1

All regressions are OLS. Standard errors in parentheses and are clustered at the market level.

Covariates are farmer's age and gender; the amount of loan taken for chemicals BIOMITRID, TOP10, K6%, and PRO 64.8%;

and area for planting cotton that the farmer declared at the time of pesticide receipt; stratifiers (agency fixed effects and good access to charging station).

Covariates are replaced with zero when missing, accompanied by dummies for missingness.

6a. Survey results – GAP results I

VARIABLES	Standardized knowledge score: Farm preparation	Standardized knowledge score: Farm preparation	Standardized knowledge score: Farm preparation	Standardized knowledge score: Farm preparation	Standardized knowledge score: Cotton protection	Standardized knowledge score: Cotton protection	Standardized knowledge score: Cotton protection	Standardized knowledge score: Cotton protection	Standardized knowledge score: Cotton planting	Standardized knowledge score: Cotton planting	Standardized knowledge score: Cotton planting	Standardized knowledge score: Cotton planting
Original treatment status of markets as per randomization	0.046	0.078	0.039	0.061	0.083	0.026	0.093	0.074	0.148**	0.157*	0.153***	0.146**
	(0.067)	(0.082)	(0.067)	(0.072)	(0.074)	(0.101)	(0.060)	(0.072)	(0.065)	(0.090)	(0.054)	(0.066)
Observations	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479
Adjusted R-squared	-0.000	0.001	0.037	0.060	0.001	-0.001	0.074	0.079	0.005	0.006	0.068	0.093
Control mean	-0.04	-0.08	-0.04	-0.08	-0.08	-0.12	-0.08	-0.12	-0.10	-0.15	-0.10	-0.15
Covariates	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Sampling weights	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1

All regressions are OLS. Standard errors in parentheses and are clustered at the market level.

Covariates are farmer's age and gender; the amount of loan taken for chemicals BIOMITRID, TOP10, K6%, and PRO 64.8%;

and area for planting cotton that the farmer declared at the time of pesticide receipt; stratifiers (agency fixed effects and good access to charging station).

Covariates are replaced with zero when missing, accompanied by dummies for missingness.

6b. Survey results – GAP results II

VARIABLES	Standardized knowledge score: Timing pesticide use	Standardized knowledge score: Timing pesticide use	Standardized knowledge score: Timing pesticide use	Standardized knowledge score: Timing pesticide use	Standardized knowledge score: Pesticide use protocol	Standardized knowledge score: Pesticide use protocol	Standardized knowledge score: Pesticide use protocol	Standardized knowledge score: Pesticide use protocol	Standardized knowledge score: Timing harvest	Standardized knowledge score: Timing harvest	Standardized knowledge score: Timing harvest	Standardized knowledge score: Timing harvest
Original treatment status of markets as per randomization	0.030	0.058	0.023	0.027	0.034	0.076	0.018	0.045	-0.006	0.096	-0.002	0.033
	(0.067)	(0.075)	(0.065)	(0.071)	(0.075)	(0.084)	(0.076)	(0.082)	(0.089)	(0.109)	(0.077)	(0.100)
Observations	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479
Adjusted R-squared	-0.000	0.000	0.027	0.028	-0.000	0.001	0.013	0.032	-0.001	0.002	0.072	0.062
Control mean	-0.01	0.01	-0.01	0.01	-0.04	-0.05	-0.04	-0.05	0.03	0.04	0.03	0.04
Covariates	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Sampling weights	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1

All regressions are OLS. Standard errors in parentheses and are clustered at the market level.

Covariates are farmer's age and gender; the amount of loan taken for chemicals BIOMITRID, TOP10, K6%, and PRO 64.8%; and area for planting cotton that the farmer declared at the time of pesticide receipt; stratifiers (agency fixed effects and good access to charging station).

Covariates are replaced with zero when missing, accompanied by dummies for missingness.

6c. Survey results – GAP results III

VARIABLES	Standardized knowledge score: Benefits of early harvest	Standardized knowledge score: Benefits of early harvest	Standardized knowledge score: Benefits of early harvest	Standardized knowledge score: Benefits of early harvest	Standardized knowledge score: Harvesting when it rains	Standardized knowledge score: Harvesting when it rains	Standardized knowledge score: Harvesting when it rains	Standardized knowledge score: Harvesting when it rains	Standardized knowledge score: Cotton drying	Standardized knowledge score: Cotton drying	Standardized knowledge score: Cotton drying	Standardized knowledge score: Cotton drying
Original treatment status of markets as per randomization	0.040	0.113	0.042	0.082	-0.020	0.031	-0.002	0.003	0.021	0.070	0.001	0.013
	(0.064)	(0.077)	(0.056)	(0.070)	(0.065)	(0.074)	(0.059)	(0.064)	(0.068)	(0.083)	(0.062)	(0.070)
Observations	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479
Adjusted R-squared	-0.000	0.003	0.040	0.043	-0.001	-0.000	0.034	0.041	-0.001	0.001	0.034	0.046
Control mean	-0.04	-0.07	-0.04	-0.07	0.01	0.00	0.01	0.00	0.01	0.02	0.01	0.02
Covariates	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Sampling weights	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1

All regressions are OLS. Standard errors in parentheses and are clustered at the market level.

Covariates are farmer's age and gender; the amount of loan taken for chemicals BIOMITRID, TOP10, K6%, and PRO 64.8%;

and area for planting cotton that the farmer declared at the time of pesticide receipt; stratifiers (agency fixed effects and good access to charging station).

Covariates are replaced with zero when missing, accompanied by dummies for missingness.

6d. Survey results – GAP results IV

VARIABLES	Standardized knowledge score: Cotton storage	Standardized knowledge score: Cotton storage	Standardized knowledge score: Cotton storage	Standardized knowledge score: Cotton storage	Standardized knowledge score: Preparation for sale	Standardized knowledge score: Preparation for sale	Standardized knowledge score: Preparation for sale	Standardized knowledge score: Preparation for sale	Index for knowledge of GAPs	Index for knowledge of GAPs	Index for knowledge of GAPs	Index for knowledge of GAPs
Original treatment status of markets as per randomization	0.017	0.014	0.025	0.007	0.072	0.039	0.062	-0.012	0.043*	0.069***	0.044**	0.047**
	(0.059)	(0.080)	(0.057)	(0.074)	(0.064)	(0.089)	(0.059)	(0.079)	(0.023)	(0.025)	(0.020)	(0.023)
Observations	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479
Adjusted R-squared	-0.001	-0.001	0.009	0.020	0.001	-0.000	0.036	0.030	0.003	0.008	0.065	0.073
Control mean	-0.01	0.00	-0.01	0.00	-0.02	0.01	-0.02	0.01	-0.03	-0.04	-0.03	-0.04
Covariates	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Sampling weights	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1

All regressions are OLS. Standard errors in parentheses and are clustered at the market level.

Covariates are farmer's age and gender; the amount of loan taken for chemicals BIOMITRID, TOP10, K6%, and PRO 64.8%;
and area for planting cotton that the farmer declared at the time of pesticide receipt; stratifiers (agency fixed effects and good access to charging station).

Covariates are replaced with zero when missing, accompanied by dummies for missingness.

6e. Survey results – GAP results for cotton planting I

VARIABLES	Farm preparation: Make sure you have good soil	Farm preparation: Make sure you have good soil	Farm preparation: Clear the land of the previous crop	Farm preparation: Clear the land of the previous crop	Farm preparation: Check the soil's humidity	Farm preparation: Check the soil's humidity	Farm preparation: Crop rotation	Farm preparation: Crop rotation	Farm preparation: Make sure the land is ploughed properly	Farm preparation: Make sure the land is ploughed properly	Cotton protection: Weeding	Cotton protection: Weeding
Original treatment status of markets as per randomization	-0.001	-0.002	0.012	0.006	-0.002	-0.002	0.026	0.017	0.023	0.024	0.030*	0.025*
	(0.020)	(0.017)	(0.018)	(0.015)	(0.015)	(0.013)	(0.029)	(0.027)	(0.030)	(0.027)	(0.016)	(0.014)
Observations	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479
Adjusted R-squared	-0.001	0.031	0.000	0.014	-0.001	0.025	0.001	0.032	0.000	0.039	0.004	0.017
Control mean	0.08	0.08	0.93	0.93	0.05	0.05	0.15	0.15	0.17	0.17	0.93	0.93
Covariates	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1

All regressions are OLS and use sampling weights. Standard errors in parentheses and are clustered at the market level.

Covariates are farmer's age and gender; the amount of loan taken for chemicals BIOMITRID, TOP10, K6%, and PRO 64.8%;
and area for planting cotton that the farmer declared at the time of pesticide receipt; stratifiers (agency fixed effects and good access to charging station).

Covariates are replaced with zero when missing, accompanied by dummies for missingness.

6f. Survey results – GAP results for cotton planting II

VARIABLES	Cotton protection: Use pesticides	Cotton protection: Use pesticides	Cotton protection: Thinning	Cotton protection: Thinning	Cotton protection: Sow early	Cotton protection: Sow early	Cotton planting: Space the seeds out when planting	Cotton planting: Space the seeds out when planting	Cotton planting: Ensure the soil is moist enough	Cotton planting: Ensure the soil is moist enough	Cotton planting: Sow the seeds in a straight line	Cotton planting: Sow the seeds in a straight line
Original treatment status of markets as per randomization	-0.010	0.008	-0.012	0.003	0.011	0.016	0.051	0.046	0.009	0.005	0.015	0.020
	(0.033)	(0.027)	(0.041)	(0.027)	(0.020)	(0.018)	(0.033)	(0.029)	(0.009)	(0.008)	(0.031)	(0.021)
Observations	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479	1,479
Adjusted R-squared	-0.000	0.045	-0.000	0.075	-0.000	0.009	0.005	0.039	0.000	0.025	0.000	0.104
Control mean	0.85	0.85	0.79	0.79	0.09	0.09	0.83	0.83	0.02	0.02	0.90	0.90
Covariates	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1

All regressions are OLS and use sampling weights. Standard errors in parentheses and are clustered at the market level.

7. Voice and text pilot evaluation results

VARIABLES	Have you ever contacted JFS-SAN using the phone?	Have you ever contacted JFS-SAN using the phone?	=1(if received voice/text message)	=1(if received voice/text message)	Percentage of messages a farmer recalled	Percentage of messages a farmer recalled	Retention (=1 if farmer grew cotton in the season of 16/17)	Retention (=1 if farmer grew cotton in the season of 16/17)
=1(if voice message)	-0.050	-0.051	0.040	0.032	4.532**	5.174**	0.057	0.063*
	(0.047)	(0.046)	(0.034)	(0.034)	(2.127)	(2.192)	(0.037)	(0.036)
Observations	400	400	400	400	283	283	421	421
Adjusted R-squared	0.000	0.036	0.001	0.031	0.013	0.012	0.003	0.062
Control mean	0.34	0.34	0.84	0.84	26.13	26.13	0.80	0.80
Covariates	No	Yes	No	Yes	No	Yes	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1
All regressions are OLS. Standard errors in parentheses and are clustered at the market level.
Covariates are farmer's age and gender; the amount of loan taken for chemicals BIOMITRID, TOP10, K6%, and PRO 64.8%; and area for planting cotton that the farmer declared at the time of pesticide receipt.
Covariates are replaced with zero when missing, accompanied by dummies for missingness.

Appendix D: Summary statistics

Summary statistics for the large-scale impact evaluation

VARIABLES	N	mean	p50	sd	min	max
Cotton sold (Kg)	1,797	366.7	252	453.1	0	3,600
Total income from cotton sold (MZN)	1,797	7,909	4,320	10,698	0	84,672
Cotton yield: cotton produced per hectare	1,470	318.9	288	243.6	0	1,800
How much land did you use to grow cotton (in acres) this season?	1,470	1.392	1	0.936	0.500	14
Retention (=1 if farmer grew cotton in the season of 16/17)	1,797	0.823	1	0.382	0	1
Standardized knowledge score: Farm preparation	1,479	-0.0112	-0.575	1.014	-1.865	4.584
Standardized knowledge score: Cotton protection	1,479	-0.0322	0.362	1.004	-3.744	1.730
Standardized knowledge score: Cotton planting	1,479	-0.0125	0.397	0.953	-3.929	2.560
Standardized knowledge score: Timing pesticide use	1,479	0.0124	0.614	0.991	-1.617	0.614
Standardized knowledge score: Pesticide use protocol	1,479	-0.0205	0.219	1.011	-1.303	2.501
Standardized knowledge score: Timing harvest	1,479	0.0233	0.995	1.000	-1.004	0.995
Standardized knowledge score: Benefits of early harvest	1,479	-0.0163	0.0708	1.023	-1.896	3.022
Standardized knowledge score: Harvesting when it rains	1,479	-0.00334	-0.788	0.997	-0.788	1.262
Standardized knowledge score: Cotton drying	1,479	0.0185	0.883	0.998	-1.133	0.883
Standardized knowledge score: Cotton storage	1,479	-0.000861	-0.221	0.992	-1.849	3.035
Standardized knowledge score: Preparation for sale	1,479	0.0231	-0.835	1.010	-0.835	2.318
Index for knowledge of GAPs	1,479	-0.00356	-0.00643	0.367	-1.387	1.128
The farmer's age	1,050	39.98	39	14.74	14	87
=1(if female farmer)	1,797	0.306	0	0.461	0	1
Size of land declared by farmer	1,311	1.047	1	0.614	0.100	8
Credit for chemical: BIOMITRID	1,356	67.11	50	39.54	50	500
Credit for chemicals: TOP10	1,761	386.4	250	276.3	25	4,000
Credit for chemicals: K6%	1,267	417.9	250	323.4	250	3,000
Credit for chemicals: PRO 64.8%	636	579.4	500	574.9	250	9,000
Access to charging in the market	1,654	0.767	1	0.423	0	1

Summary statistics for the voice and text pilot

VARIABLES	N	mean	p50	sd	min	max
Have you ever contacted JFS-SAN using the phone?	400	0.318	0	0.466	0	1
=1(if received voice/text message)	400	0.863	1	0.345	0	1
Percentage of messages a farmer recalled	283	28.32	28.57	17.90	0	85.71
Retention (=1 if farmer grew cotton in the season of 16/17)	421	0.824	1	0.381	0	1
The farmer's age	260	36.48	36	14.63	14	82
=1(if female farmer)	421	0.356	0	0.479	0	1
Size of land declared by farmer	262	1.137	1	0.729	0.500	8
Credit for chemical: BIOMITRID	224	72.77	50	46.82	50	400
Credit for chemicals: TOP10	313	425.7	250	358.4	250	4,000
Credit for chemicals: K6%	221	483.0	250	358.3	250	3,000
Credit for chemicals: PRO 64.8%	113	699.1	500	899.6	250	9,000

Appendix E: CSRM evaluation survey instrument

Question no	Potential question	Potential Response options	Skip pattern	Rationale	Themes
1	Surveyor name				**Surveyor details**
2	Market name				
3	Do you wish to participate in the survey?	a. Yes b. No	If b.>> skip to the end of the survey		**Informed consent**
4.a	Is the respondent's full name xxxxxx?	a. Yes b. No		**Get demographic data on the Farmers**	**Farmer details**
4.b	Do you have any other names in addition to xxxxxx?	a. Yes b. No	If b.>>skip to 5		
4.c	If yes, please enter the other names				
5	Gender of respondent	a. Female b. Male			
6	What is your year of birth?				
7	What is the highest level of education that you have completed? (surveyor: please note year COMPLETED)	a. Grade 1 b. Grade 2 c. Grade 3 d. Grade 4 e. Grade 5 f. Grade 6 g. Grade 7 h. Grade 8 i. Grade 9 j. Grade 10 k. Grade 11 l. Grade 12 m. College n. No schooling			
8	Do you have a producer card given by JFS SAN?	a. Yes b. No	If b.>>skip to 9b		

9	What is the number of your producer card?				
9.a	Can we take a photograph of your card? (Surveyor please take a picture of the farmer producer card)	a. Yes b. No			
9.b	What happened to the producer card provided by JFS SAN?	a. I never received one b. I lost my card c. Cannot find card d. Returned to JFS e. Other (specify)			
10	Do you have a phone provided by JFS?	a. Yes b. No	If a.>> skip to 10. b	**Understand what farmers are using the phones for, their interaction with JFS, and their reasons for/for not interacting with JFS**	**JFS phones**
10. a	What happened to the phone you received?	a. It got lost b. I gave it to someone c. It broke/ stopped working d. Other (specify)	Skip to >>38		
10.b	What is the phone number for the phone JFS gave you?				
11	Do you have another phone?	a. Yes b. No	If b.>>skip to 12		
11.a	What is the telephone number for the other phone?				
11.b	Do you usually keep this other phone charged?	a. Yes b. No c. Sometimes			
11.c	Which phone do you use more regularly?	a. JFS phone b. Other phone c. Use both equally d. Other (specify)			
12	Can we look at your phone now? (Surveyor: check if the phone is on or off)	a. Phone is on b. Phone is off c. Doesn't have phone on them	If a. or c. >> skip to 13		
12.a	Why is your phone switched off?	a. The battery is dead			

		b. I have no need for it now c. To save my battery d. My charger does not work			
		e. There is no network at my house/ here f. Other (specify)			
12.b	How often is your phone switched off?	a. Always b. Sometimes c. Never			
13	How is the network/signal in your area?	a. Not good b. Sometimes it is good c. Always good			
14	What do you use this JFS phone for? (Select all that apply)	a. Calling/ messaging other people b. Contacting (messaging or calling) JFS c. Flashlight d. Other (specify)			
15	Have you ever received text or voice messages from JFS?	a. Yes b. No	If a.>>skip to 17		
16	Have you heard about the tips from friends or neighbours?	a. Yes b. No	If a.>> skip to 21 If b.>> skip to 24		
17	What messages did you receive?	a. Voice messages b. Text messages			
18	In the last week, how many messages do you receive from JFS?	a. One b. Two c. Three d. More than three e. Does not remember			
19	Do you understand these messages?	a. Yes b. No	If a.>> skip to 20		
19.a	Why don't you understand the messages? (Select all that apply)	a. I don't understand the messages	Skip to >> 24		

		b. I don't understand the content c. I can't read d. Other (specify)		
20	What information do the messages provide?	a. Pest control b. Weeding c. Weather d. Harvesting time/ principles e. Post-harvest land management f. Cotton price information g. Other (specify)		
21	How often are the tips different from your normal farming practices?	a. Always b. Sometimes c. Never d. Don't know		
22	When the tips are different from what you usually do, how often do you change your practice to match the tips?	a. Always b. Sometimes c. Never d. Don't know	If c.>> skip to 23	
23	Why don't you change your practice to match the information in the tips?	a. I received/saw the message too late b. I did not understand the message c. I did not have the money/resources to implement the change d. I did not believe the message would help me e. Other (specify)		
24	We have heard that some people are not receiving messages, do you know why this is the case? (Select all that apply)	a. They do not have a phone b. The phone is off c. The network is not good d. Their battery died		

		e. Other (specify)			
25	Have you ever contacted JFS using the phone?	a. Yes b. No	If b.>>skip to 30		
26	How many times have you contacted JFS in the last week?	a. Once b. Less than 3 times c. More than 3 times but less than 5 times d. More than 5 times e. I do not recall f. None			
27	When was the last time you contacted JFS?	a. Today b. This week c. More than 1 week but less than 2 weeks ago d. More than 2 weeks but less than 1 month ago e. Last month f. More than a month ago			
28	How did you contact them?	a. Text message b. Phone call			
29	What was your enquiry to JFS? (Select all that apply)	a. Advice on planting cotton b. Advice on harvesting cotton c. Advice on pest control d. Request for pesticides/chemicals e. Request for harvest bags f. Request for subsidy g. Request for the price of the chemicals h. Reporting phone issues, i.e., phone not working, SMS not getting through, battery not working			

		i. Confirming that the JFS contact number works j. Request for a loan k. Advice on administration issues e.g., producer cards l. Enquiry on cotton pricing m. Requesting JFS to come and buy cotton n. Requesting a visit from a tecnico or to speak to a specific tecnico			
		o. Confirm if there is a meeting with a JFS official or if the tecnico is going to a specific market			
		p. Responding to a question from JFS q. Other (specify)			
30	Why have you never contacted JFS?	a. I have had no enquiries b. I have not been able to reach JFS staff, e.g., no one picks up, the phone does not go through c. I did not know that I could contact them d. I don't have their contact details e. My phone does not have battery f. I don't have airtime g. JFS can't help h. Other (specify)			
31	Do you enjoy the JFS text/voice messaging program?	a. Yes b. No	If b.>> skip to 33	**Understand whether the producers are happy with the service and why**	**Producer satisfaction of the JFS service**
32	Why do you enjoy the program?	a. The messages are sent at the right time when I can use them b. The messages are useful			

		c. Other (specify)			
33	Why don't you enjoy the program?	a. I don't receive/see the messages on time b. I don't understand the messages c. The messages are not useful d. Other (specify)			
34	What language do you prefer to receive your messages in?	a. Macua b. Portuguese			
35	Did you learn anything new from the JFS messages that you did not already know?	a. Yes b. No	If b.>>37		
36	What new information did you learn?	a. How and when to spray pesticides b. When to sell cotton c. When to harvest cotton d. How to dry cotton e. How to bag cotton f. Health information g. How to plant cotton h. Other (specify)			
37	Is there any other information that you would like to receive that you do not currently receive	a. Yes b. No			
38	Did you grow cotton **this season**?	a. Yes b. No	If b.>>skip to 56	**Asking about Good Agricultural Practices (GAPs) and other JFS messages**	**Cotton harvesting and selling**
38.a	How much land did you use to grow cotton (in acres) **this season**?				
39.b	Have you harvested any cotton so far in this season?	a. Yes b. No c. Other (specify)	If a.>> skip to 39. d		
39.c	When do you intend on harvesting your cotton	a. September			

		b. October c. I have already harvested all my cotton			
39.d	How many bags have you harvested so far?				
39.e	Do you expect to harvest more cotton this season?	a. Yes b. No	If b.>>skip to 40		
39.f	When do you intend on harvesting the rest of your cotton for this season?	a. September b. October c. I have already harvested all my cotton			
39.g	How many more bags of cotton do you think you will harvest this season?				
40	Have you sold any cotton this season?	a. Yes b. No	If b.>>skip to 40. b		
40.a	How many bags have you sold so far?				
40.b	When do you intend on selling the rest of your cotton for this season?	a. September b. October c. I have already harvested all my cotton d. Don't know			
41.b	What price did you receive for selling 1 kg of cotton **this season**?	a. 23 MT b. 24 MT c. Other (specify)			
41.c	Do you have a receipt of sale for cotton this season? (Surveyor: Please take picture of receipt)	a. Yes b. No			
42	What is the current price of cotton?	a. 20 MT b. 21 MT c. 22 MT d. 23 MT e. Does not know			

43	How does the price of cotton vary from the beginning to the end of the selling season?	a. Price increases b. Price remains the same c. Price goes down d. Does not know			
44	How should you prepare your farm for planting? (Select all that apply)	a. Make sure you have good soil b. Clear the land of the previous crop c. Check the soil's humidity d. Crop rotation e. Make sure the land is ploughed properly f. Burn the previous crop g. Other (specify)			**Cotton planting**
45	What do you do not to lose your cotton? (Select all that apply)	a. Weeding b. Use pesticides c. Thinning d. Sow early e. Other (specify) f. Don't know			
46	What is the best way to sow cotton seeds?	a. Space the seeds out when planting b. Ensure the soil is moist enough c. Sow the seeds in a straight line d. Other (specify)			
47	This season, how did you know when rains were going to begin?	a. Did not know b. Neighbours or friends c. Radio d. JFS Mobile phone messages e. I saw the weather changing when the rains began f. Prior experience			**Weather forecast**

		g. Other			
48	When do you think you should spray pesticides?	a. When you see a bug in the crop b. When the cotton starts opening c. Anytime the crop is in the field d. Other (specify) e. Does not know			**Pesticide use**
49	What should you take care of while spraying pesticides?	a. Wear long-sleeved clothing, gloves b. Cover the mouth c. Spray against the wind d. Do not eat, drink, or smoke e. Don't wash materials in rivers and well f. Other (specify) g. Does not know			
50	How do you know it is time to harvest?	a. When half of the cotton field has all capsules open b. When all the cotton plants have all capsules open c. When cotton starts opening d. When my neighbour starts harvesting e. When the Activista tells me to harvest f. Other (specify) g. Does not know			**Harvesting and bagging cotton**
51	Why is it advisable to pick cotton early? (Select all that apply)	a. Preserve quality of cotton fibre b. Protect from rain c. Get better prices d. Protect from pests e. Cotton weighs more			

		f. Other (specify)			
52	What should you do if the cotton is opening and it is staring to rain?	a. Pick the cotton and put it in the dryer b. Leave it in the field c. Other (specify) d. Don't know			
53	How do you dry your cotton?	a. Put it out on a dryer b. Leave it in the field to dry naturally c. I don't know d. Other (specify)			**Cotton drying**
54	How should you harvest and bag the cotton to maintain the quality of the cotton? (Select all that apply)	a. Dry the cotton b. Separate the primary cotton from the secondary quality cotton and do not mix while bagging c. Do not fill the bag to the brim d. Nothing needs to be done e. Other (specify) f. Don't know			**Cotton storage**
55	What do you do when you have cotton ready for the market (Select all that apply)	a. Call the Activista/tecnico b. Wait for information from the Activista c. Stay in the market until JFS-SAN sees you d. Call JFS-SAN to inform them e. Other (specify) f. Don't know			**Preparation for sale**
56	Did you receive chemicals from JFS **last season**?	a. Yes b. No			
57	Will you grow cotton next season?	a. Yes b. No	If a. or c. >> skip to 58		**Growing cotton next season**

		c. Don't know			
57.a	Why will you not grow cotton next season?	a. I want to try another crop with higher profits b. I did not have a good crop this year c. I am not happy with JFS d. Cotton is difficult to grow e. Other (specify)			
58	Do you listen to the JFS radio program?	a. Yes b. No c. Sometimes	If b.>> skip to the end of the survey		**JFS Radio program**
58.a	What day does JFS SAN radio program air?	a. Monday b. Tuesday c. Wednesday d. Thursday e. Friday f. Saturday g. Sunday			
58.b	What information do you get from the radio program? (Select all that apply)	a. Cotton planting tips b. Cotton harvesting tips c. Pest management tips d. Post-harvest management tips e. Health tips f. Weather information g. Other (specify)			