



Precision
Agriculture for
Development

Mid-Term Evaluation of IVR/SMS Project: Findings and Recommendations

February 21, 2018

➤ Context

Key Insights

Recommendations

Path forward

Background on ATA

- Initiative of the Government of Ethiopia, established by federal regulation to promote agricultural sector transformation in Ethiopia
- Identifies solutions to systemic bottlenecks in key program areas
- Works to transform the agricultural sector across seven program verticals:
 - Crops and Natural Resources
 - Crops and Livestock
 - Livestock
 - Cross-cutting Initiatives
 - Agri-Business & Markets
 - Strategic Services
 - Agricultural Commercialization Cluster (ACC)

Background on IVR/SMS Project

- Introduced in February 2014
- The 8028 hotline was launched in the Amhara, Oromia, Tigray, and SNNP regions with content available in five languages on 21 crops
- So far, 27 million calls from 3.3 million registered callers to date - largest system of its kind in Africa
- ATA plans to optimize and significantly expand the system for the end of GTP II (2020)
- ATA commissioned a process evaluation of the current system in July 2017 to assess system usage

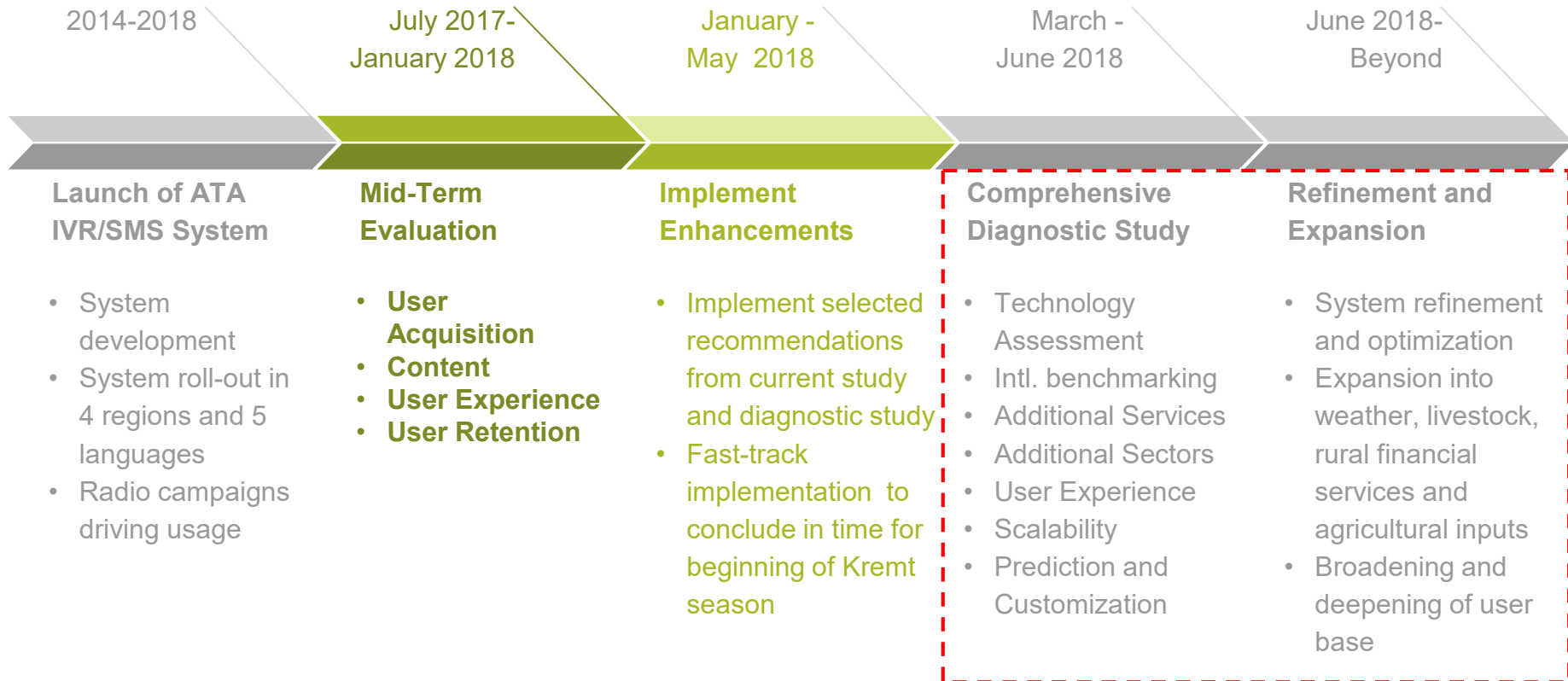
About PAD

- US-based nonprofit organization, launched Dec 2015
- Mission: To support smallholder farmers in developing countries by providing customized information and services that increase productivity, profitability, and environmental sustainability
- Goal: impact the livelihoods of millions of smallholder farmers by adapting precision agriculture technologies for developing countries
- Team of professors and experts in technology and agricultural development with considerable combined experience in Africa, South Asia and Latin America
- Currently working in 6 countries; combination of own systems and advisory services
- Signed MoU with ATA in July 2017
- Partnered with Busara Center for Behavioral Economics on this evaluation

Partners in the IVR/SMS Project

- Ministry of Agriculture and Natural Resources (MoANR)
- Regional Bureaus of Agriculture and Natural Resources (BoANRs)
- Ethiopia Institute of Agricultural Research (EIAR)
- Ethio Telecom
- Woreda Offices of Agriculture
- Digital Green
- CIMMYT

Mid-Term Evaluation in Bigger Picture

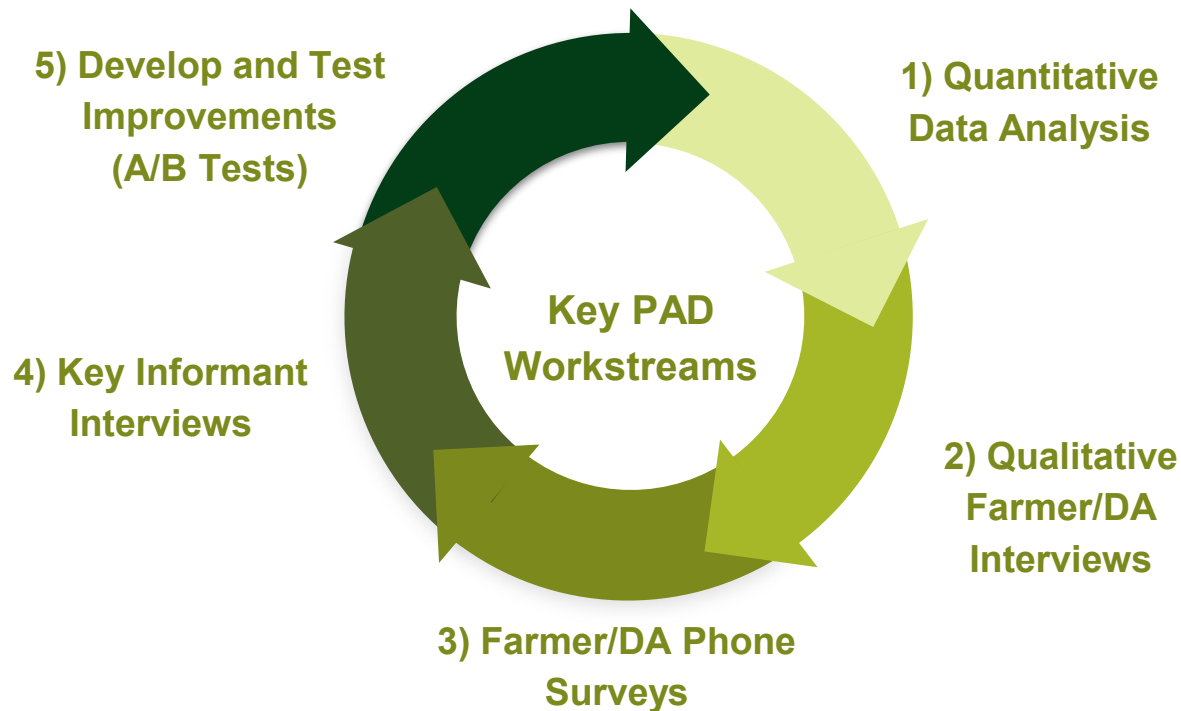


Key Objectives Aligned with TOR and Inception Report

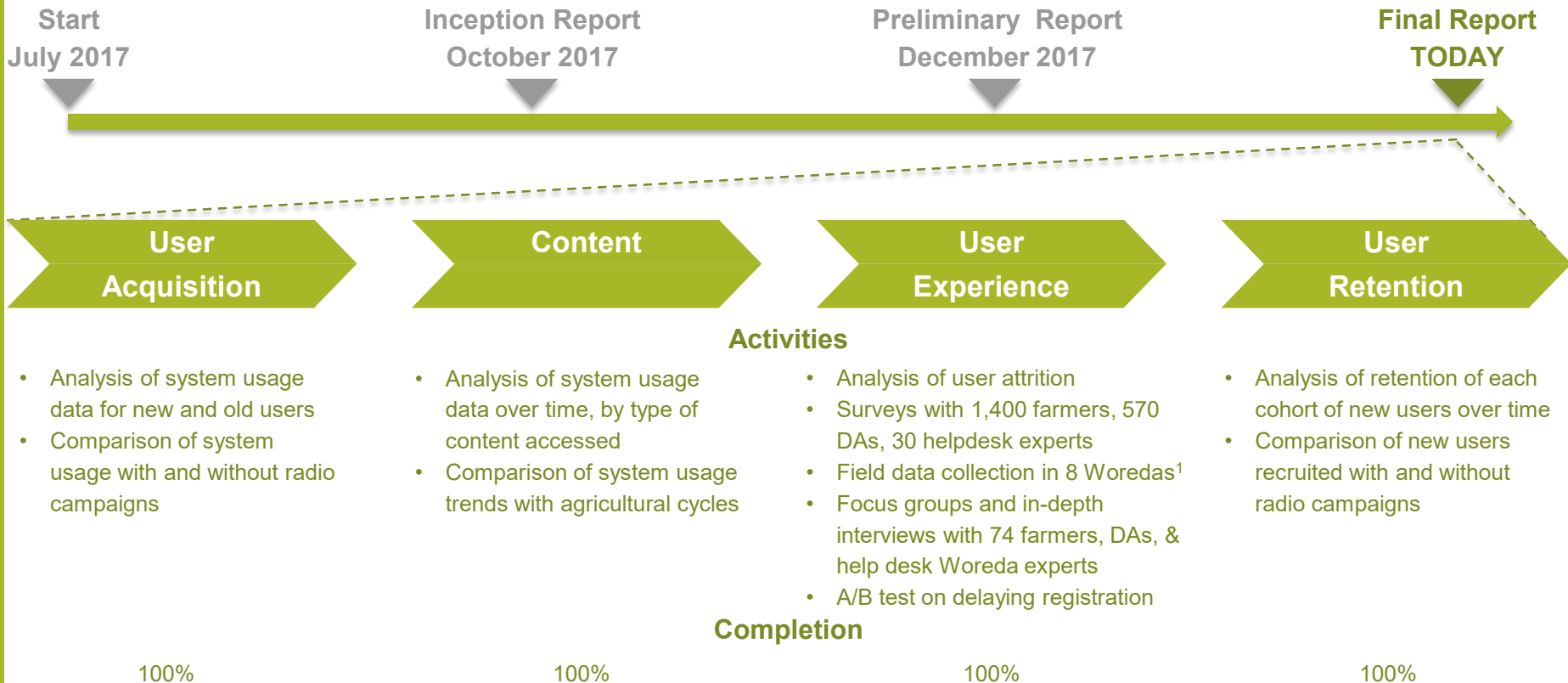
Objectives

- Assess the relevance, efficiency, effectiveness, and sustainability of the IVR/SMS system in enhancing the existing agricultural extension system
- Conduct diagnostic assessment of the IVR/SMS system
- Determine how the system could lead to improvements in information dissemination and agricultural outcomes
- Understand how farmers and DAs use the IVR/SMS service
- Identify potential areas for system improvement

Evaluation Methodology Included Five Key Workstreams



Key Activities Complete Across 4 Thematic Areas



Data Sources

- Server log data on IVR system usage and caller profiles: 250 million call events from 27 million calls by 3.3 million users over 3.5 years.
- Phone surveys with 1,400 **farmers**, 570 **DAs**, and 30 **helpdesk experts**
- Focus group discussions and in-depth interviews with 74 participants, including 64 **farmers**, 8 **DAs**, and 2 **woreda experts**
- Key Informant Interviews with 10 respondents from **ATA (4)**, **MoANR (2)**, and **Regional BoANRs (4)**

Context

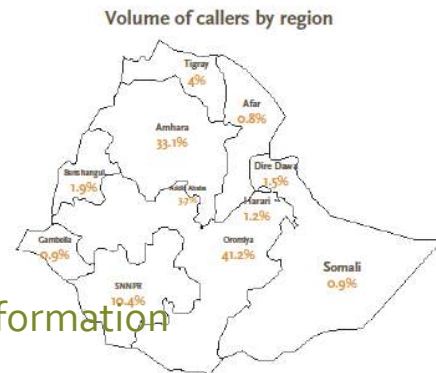
➤ Key Insights

Recommendations

Path forward

Highly Relevant System with Impressive Set of Strengths

- High initial demand (3m farmers, more than any other system of its kind in Africa)
- Comprehensive program (21 priority crops, all stages of the crop cycle, 5 main languages)
- Nationwide geographic reach
- Leverage of national telecom
- Live dashboards on system performance
- Mission-driven and embedded in broader strategy for agricultural transformation
- Support from MoANR and Regional BoANRs in terms of program's relevance and outputs
- Motivated, highly capable staff



IVR/SMS Project Can Efficiently and Effectively Improve Agricultural Extension

- Larger scale with cost effectiveness (3 million callers with low marginal cost)
- Innovations and current information can be easily and quickly disseminated
- Faster communication of alerts, e.g. information on pest control
- Possibility for customization (e.g. region, soil type, crop type etc.)
- Standardization of information without influence of human error
- More information can be disseminated through the system vs. a single person (agronomic information, financial information, etc.)

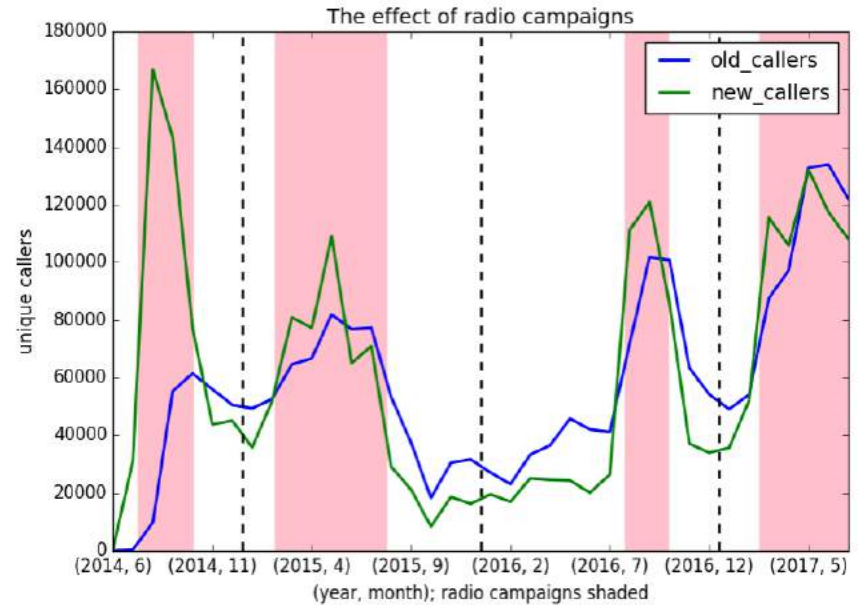
Descriptive Statistics

- Average age: 28
- Proportion female: 10%
- Literacy (reading): 89%
- Literacy (writing): 88%
- Years of education: 7.5
- Proportion students: 24%
- Proportion use chemical fertilizer: 86%
- Proportion use pesticides: 37%
- Average land size: 2.1 hectares

Radio Campaigns Drive User Acquisition



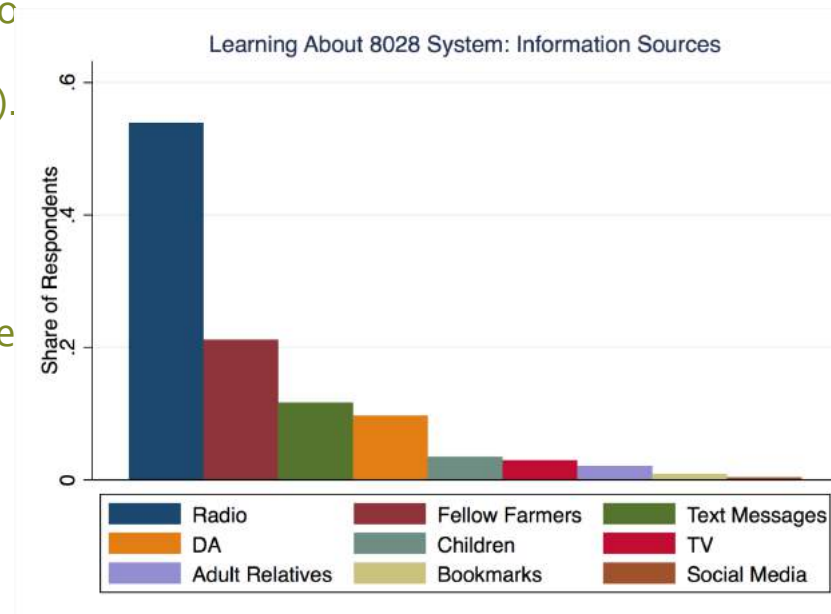
- Radio campaigns are a main driver of user acquisition and usage, including both new and old users.
- Minimal difference between campaign providers.
- The cost to acquire a new user (or get an old user back) through radio campaigns is about 10 ETB per caller, which is very cost effective.
- Not many of these users are retained (see slide 38).
- Even with low retention, there is positive long-term growth.



Radio and Fellow Farmers Are Biggest Channels to Learn About 8028



- Majority of interviewed farmers (53.9%) listed radio as primary channel to learn about the system, followed by news spread by fellow farmers (21.2%).
- DAs are not very active in spreading the word, although 95% of surveyed DAs have heard about the system.
 - Expectations to advertise IVR/SMS could be explicitly communicated to DAs
 - DAs may have too many competing tasks
- There are no connections between original source of information and level of proficiency.

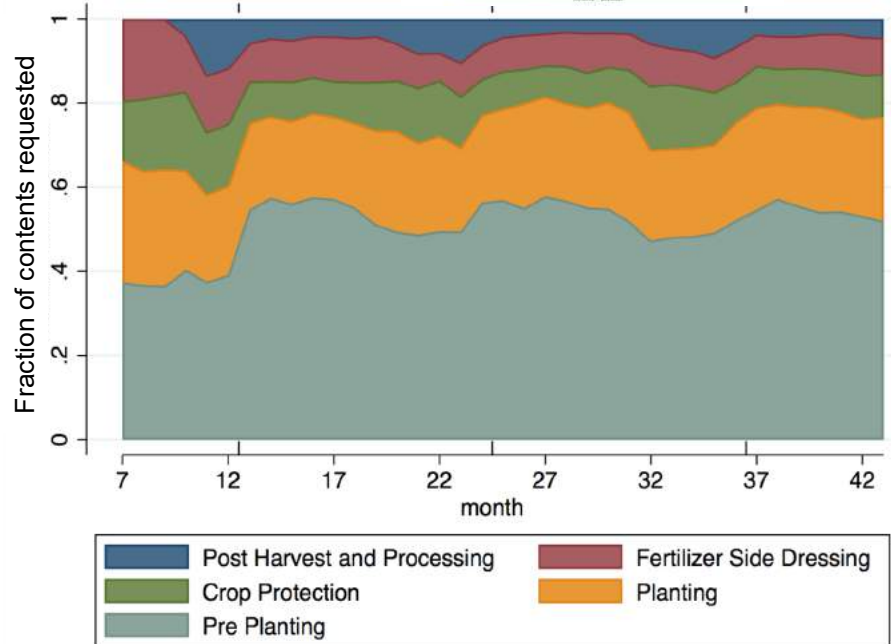
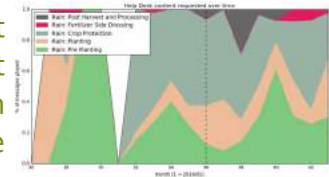


Minimal Seasonality in Content Requested

- This suggests that users do not listen to the most temporally relevant content.
- This is even true for experienced users.
- In contrast, help desk content is evenly distributed and varies seasonally
- Hypothesis: Users simply press 1 because they don't understand how to use the system.
- Users have not received training on how to effectively use the system.



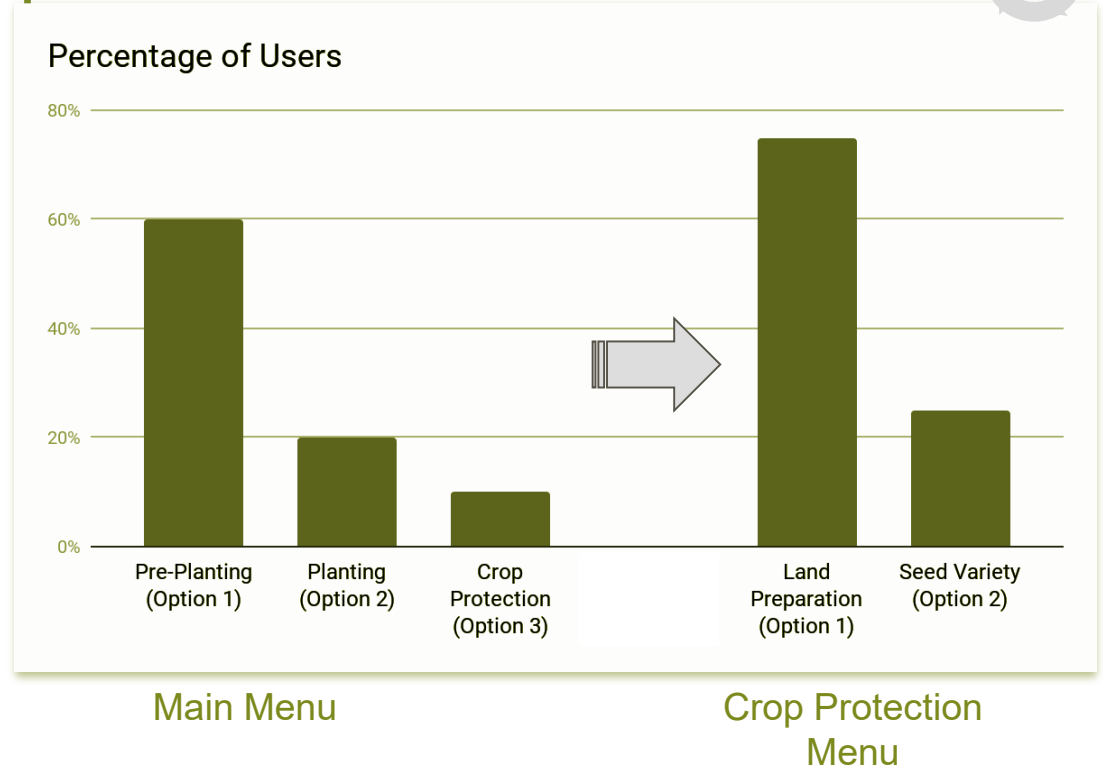
Help desk content illustrates what seasonal variation should look like



Content Requested Heavily Skewed Towards Option 1



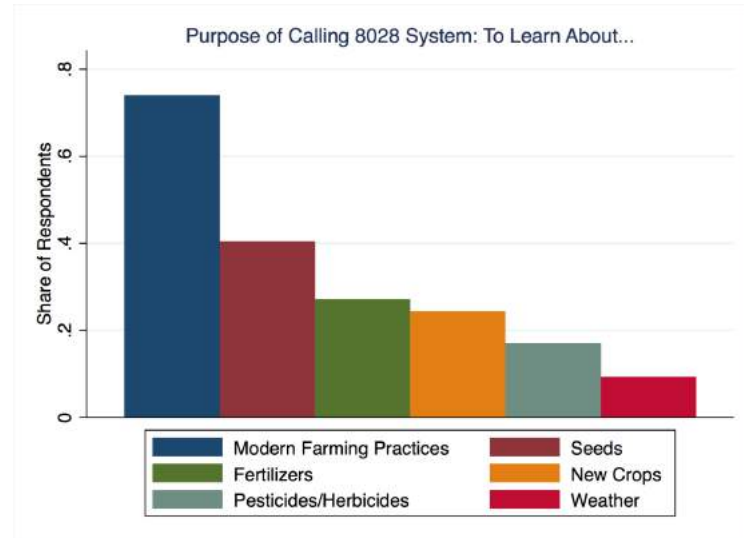
- In every menu, users exhibit a preference for pressing 1 over 2, 2 over 3, etc.
 - 80% rainfed vs. 20% irrigation
 - Within rainfed (or irrigation), 60% pre-planting, 20% planting, 10% crop protection, etc. throughout entire cropping season



Farmers Report Content Preferences and Comprehension Challenges



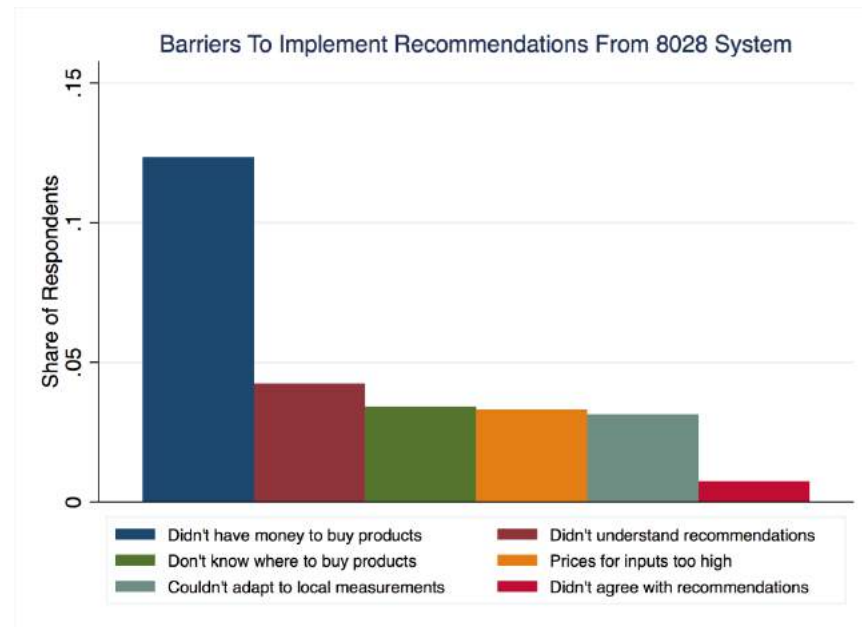
- In phone surveys, farmers report wanting to learn modern farming practices (74.1%) and products - seeds (40.5%) and fertilizers (27.2%).
- However, interview respondents report difficulties understanding recommendations. After listening to recommendations, few respondents could identify relevant information for the locality, recall fertilizers mentioned, or recommended amounts
- 29% of users report in interviews and focus groups that content includes unfamiliar technical terms, units, or soil types
- 82% of users also report that content is too long, too detailed, and open to multiple interpretations



Other Challenges also Limit Ability to Implement Recommendations



- In phone surveys, farmers report that lack of money to buy inputs like fertilizers and pesticides (12.36%) is the most important barrier to implement recommendations, rather than difficulty to understand the contents (3.05%)
- 55% of users report in interviews and focus groups that they lack understanding of how to implement recommendations
 - Skeptical of own ability (need training)
 - Think they are already implementing
- Farmers need other types of information to address these challenges, e.g. on vouchers or other financial services available



Key Informant Interviews

Reveal Opportunities to Enhance Content



- Key Informants from ATA, MoANR and Regional BoANRs all acknowledge that content could be better tailored to farmers' local needs and simplified to remove technical jargon, and could work together to improve content
- Regional and lower level stakeholders could be more involved in content development and system implementation
- Farmers could also be engaged directly in a more participatory manner to ensure content is relevant to local information needs and addresses social and cultural concerns, e.g. sensitivities around gender disparity.
- Limited understanding of content could also be addressed through better engagement with frontline extension workers, and coordination with other service providers

Additional Opportunities for Content Customization



- Existing customization
 - SMS alerts based on farmer's geography
- Potential new customizations
 - Geography-specific data from EthioSIS on soil fertility by woreda
 - Geography-specific data from HHI Value Chain on shallow groundwater mapping by woreda
 - More advanced content based on level of user experience
 - Content tailored to user preferences or other user characteristics
 - Content customized by caller type, e.g. content for DAs to cascade down to farmers
 - Content customized by past purchasing behavior, measured through IVS e-vouchers

An Introduction to A/B Tests: Develop and Test Improvements

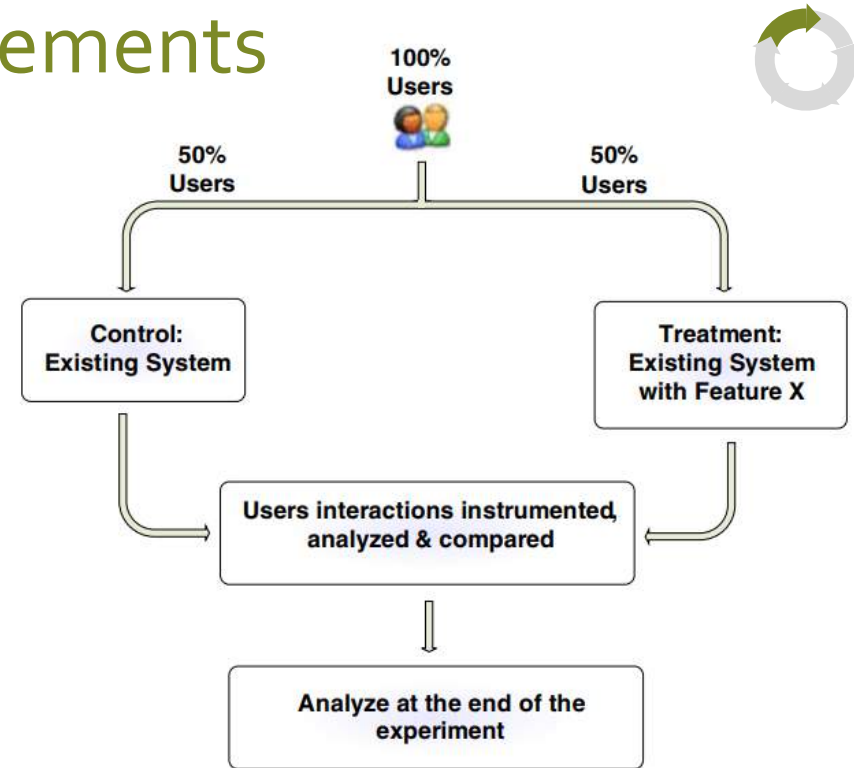
User
Acquisition

Content

User
Experience

User
Retention

- Controlled experiments in real time to evaluate changes to the system.
- Treatment & control groups are similar in everything except the intervention, so can be compared.
- Results measured in terms of interaction with the system (time spent, content accessed, retention, ...) in order to get answers quickly without costly and lengthy surveys. Useful for user experience, not for ultimate outcomes, like yields.



A/B Test in Development to Test Effect of Rotating Menu Options

User
Acquisition

Content

User
Experience

User
Retention



Rotating Menu Options with Crop Seasons

- Problem: Farmers tend to select first option on the menu.
- A/B Test: For half the farmers who call in, adjust menu options so that Option 1 the most relevant one at that point in time, rotated with the crop season; for remaining farmers, leave menu options as they are
 - Before the season, pre-planting is Option 1
 - During the planting season, planting is Option 1
 - Etc.
- Outcome: Compare proportion of users that select various options across the two groups
- Caveat: This may be potentially confusing to regular users - this is why we need to A/B test.

Suggested Process for Testing Content Changes



Ask Questions

Solicit important questions to address from farmer interviews

Get Feedback

Feedback Loop: Test content rigorously on farmers before recording:

- Are terms and measurement units clear, or are they too technical?
- Is the content actionable?

Get Feedback

Feedback Loop: Test recording rigorously on farmers before deploying:

- Is recording too fast?

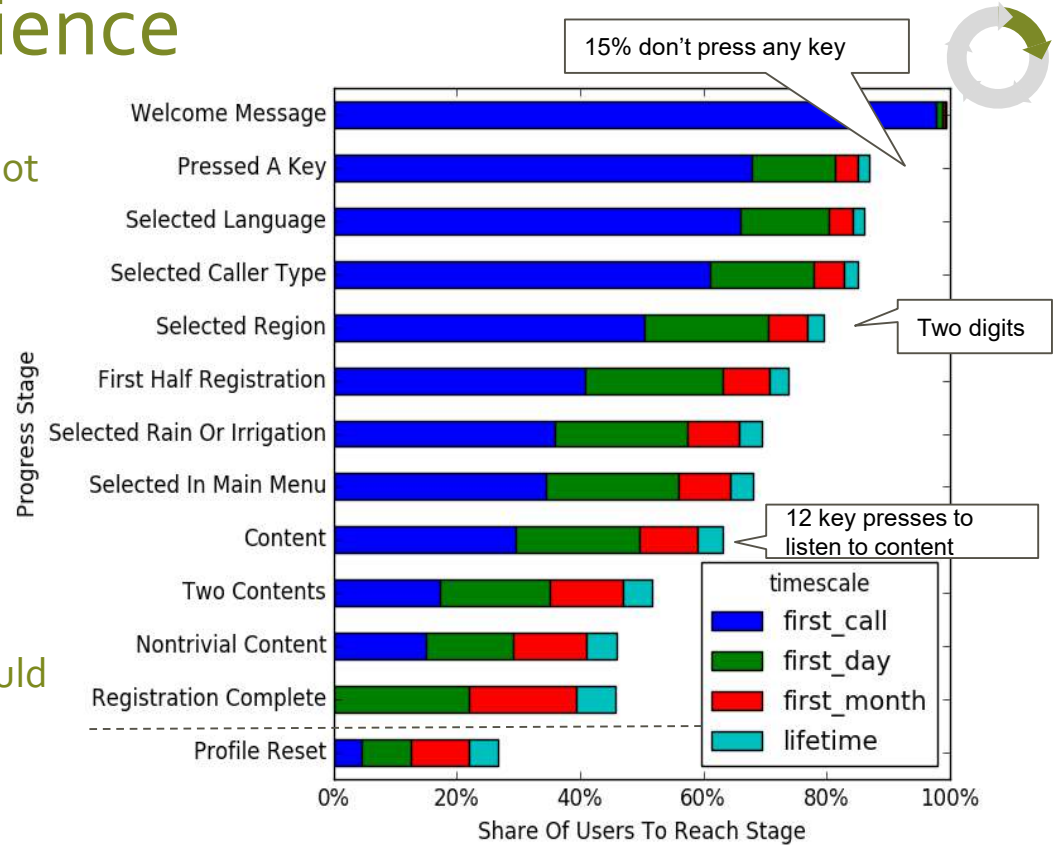
Get Feedback

Feedback Loop: What questions do people ask in the help desk?

NOTE: For changing agronomic content, more extensive approval process is required

Attrition Occurs at Every Stage in User Experience

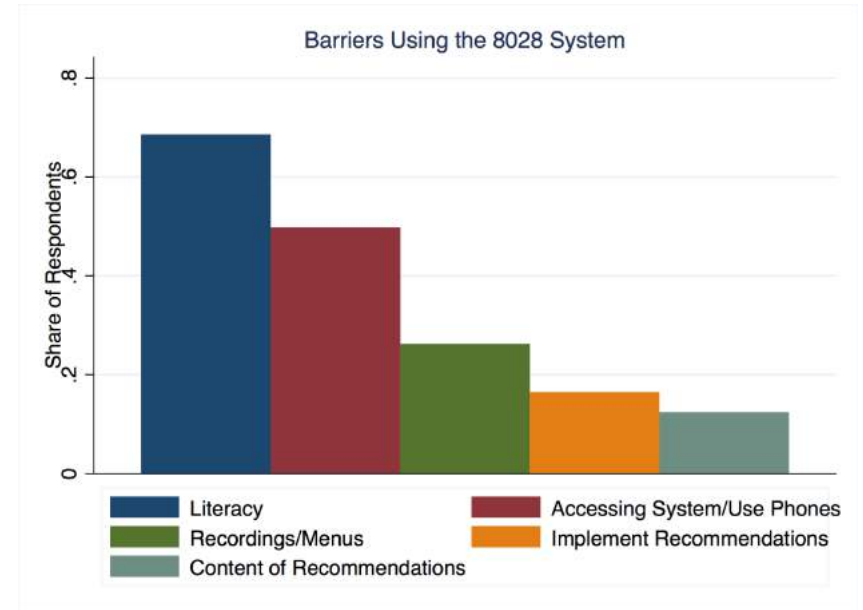
- Users despair quickly – vast majority of users reach milestones on first day, or not at all.
- There is user attrition at every stage, which adds up to undermine user retention.
- Attrition upstream can have a ripple effect on retention downstream.
- Small changes add up – cleaning up all the little details that hinder usability could lead to a dramatic increase in usage.



Usage Affected by Factors Within and Outside the IVR/SMS System



- Farmers attribute failures to use the system to factors outside the system:
 - Lack of literacy (68.7%)
 - Failure of telecom infrastructure (49.7%)
- However, respondents also have trouble with several features of the system:
 - Navigating menus and pressing required keys
 - Understanding content of recommendations
 - 20% don't understand IVR concept



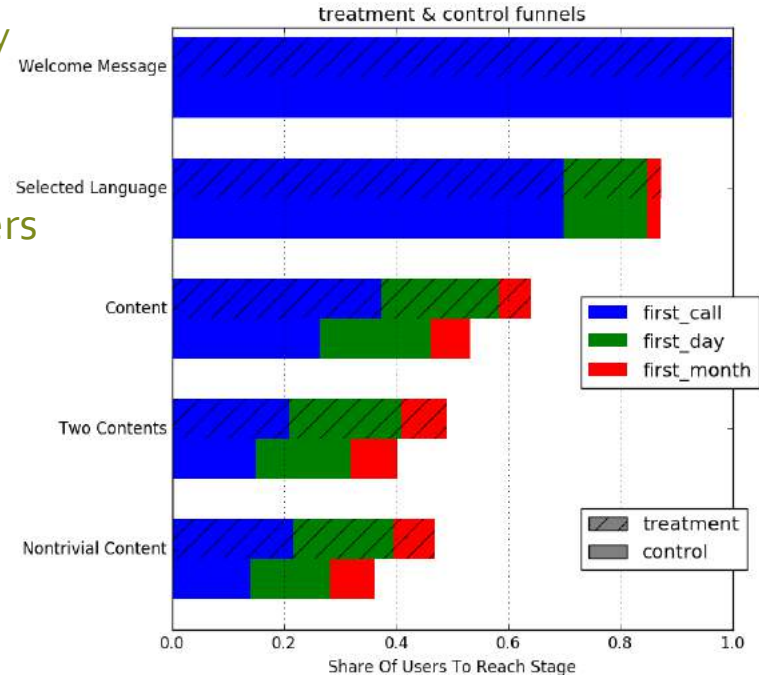
Usage Also Affected by Issues of Trust and Social Learning



- Experienced users find information quickly, but most do not teach others
- 33% of users do not always trust recommendations
 - No reported differences by level of proficiency
- These issues could potentially be addressed through more involvement from regional and local level stakeholders, frontline extension workers, other service providers, and farmers themselves

Postponing Registration Increases Content Access

- Postponing user registration (treatment) increases share of users accessing content from 52% to 63%
 - Also increases # contents, non-trivial contents (not simply pressing 1), etc.
 - These gains do not fade after several weeks.
- To give a sense of scale – 1% of new users is 500 farmers a month (or 1,000 in campaigns) – a lot!
- 5,000 more farmers access content every month, and 25,000 more contents accessed per month (up 16%)
- Users' first experience matters – when they hit snags (registration, wrong language, etc.), many give up.



A Note on Registration



- “Language bear trap”: 13-14% of users select wrong language (even among strong users)
 - Solution #1: Create unique short-code per language
 - Solution #2: Remove language from registration and include it in each call
- Responses to profiling questions are not accurate, especially for harder questions
 - Unlikely to behave strategically - not always press 1
 - Strong users more likely to be correct for **some** questions

Correct profile information entered for...	All users	Weak users (0-2 contents)	Strong users (20+ contents)
Language	85.96%	85.86%	87.42%
Region	72.70%	74.13%	76.54%
Zone	44.62%	45.39%	46.80%
Woreda	12.97%	9.79%	19.70%
Gender	45.19%	22.49%	53.90%
Caller Type	49.68%	52.03%	49.34%

User Data Collection



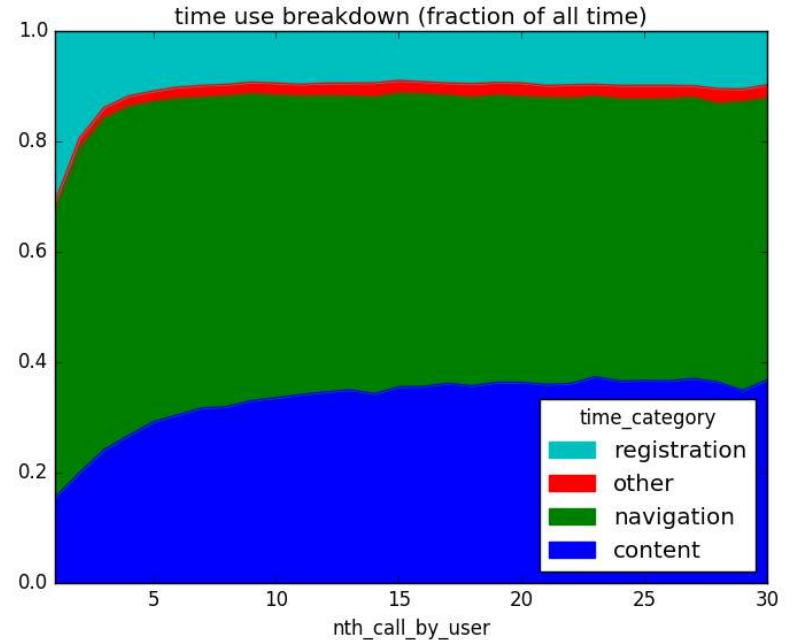
- Two distinct purposes for data collection:
 - Customize content
 - Gather statistics of IVR users (for gender, caller type, etc.)
- Customize content - recommendations:
 - Only collect what is currently used for customization (i.e. geography)
 - Explain the purpose
 - Make it optional - let farmers decide
- Gather statistics of IVR users - recommendations:
 - Enough to register / snap-survey small representative sub-sample (2%)
 - For accurate information - sample for short phone call
- Simplify registration to collect more accurate information - A/B test
- Feedback loop: Verify profile, ask why it's wrong

Correct profile information entered for...	All users
Language	85.96%
Region	72.70%
Zone	44.62%
Woreda	12.97%
Gender	45.19%
Caller Type	49.68%

Registration, Profile Resets, and Menu Navigation Limit Usage



- Even advanced users spend 10-15% of their time on the system on registration, 50% on navigation, 35% on content.
- 7% of calls reset the profile, even by advanced users.
 - o Potential Solution: Make profile reset less accessible
- Ideas for feedback loops:
 - o Mining the data
 - o Back-checks about profile reset
 - o Back-checks about user experience in general



Adding Pauses Between Language Options Had No Effect



- Problem: 15% of users never select a language. Many users complained about menus being spoken too fast.
- A/B Test: Added a longer pause between the language options, to ease understanding.
- Results: No significant effect, potentially even slight negative effect on language selection.
- Recommendations:
 - Do not implement (this is why we experiment!)
 - Consider slowing down speaking speed.

Adding Menu Replay if No Option Selected Increased Access to Content



- Problem: 15% of users never press a key on the system. After 10 seconds inactive, the system hangs up.
- A/B Test: Instead of hanging up, after 10 seconds we replayed the menu (in two select menus).
- Results:
 - Improvement in 1st call: 1% more users select language, access content (Note: 1% represents 500 farmers per month).
 - Effect fades in subsequent calls.
 - Effect remains strong for users who would have had the system hang up.
- Recommendation: Implement, and shorten inactive time before replay to 4 seconds.

Removing Prompt to Save Crop to Profile Increased Access to Content



- Problem: The system prompts users to save the selected crop to their profile before listening to content, if the crop has not been added before. Users report that this is confusing and they do not understand how to respond to the menu options.
- A/B Test: Removed this prompt.
- Results:
 - 1% increase in new users accessing content.
 - 0.1 additional content per user - 5,000 messages per month.
- Recommendations:
 - Remove the save crop to profile prompt.
 - Remove any other potential barriers to accessing content.

Other A/B Tests in Progress or Planned

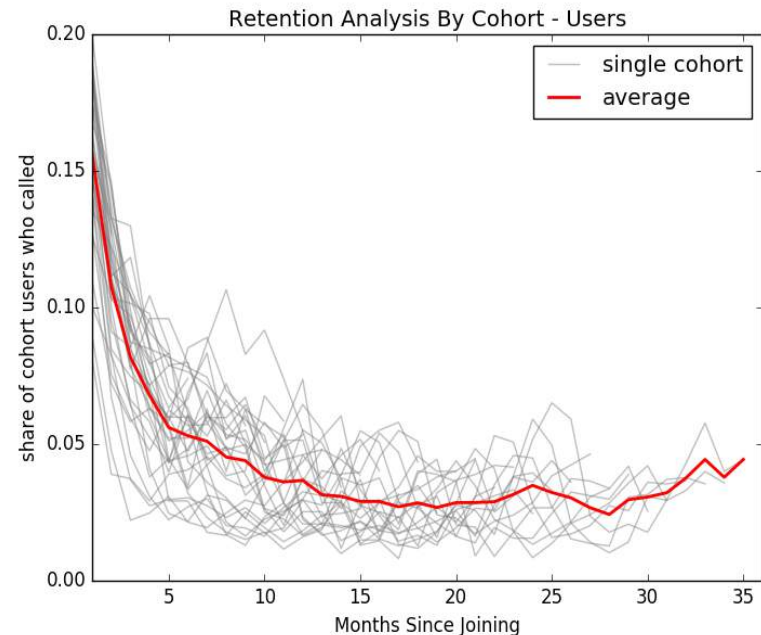


- Making profile reset less accessible.
 - Minimize mistakes causing profile reset.
- Introduction to how IVR works on first use.
 - Attempt to onboard weakest users.
- Aspirational farmer story.
- Select language at the start of every call.
- Slowing down speech in content messages.
 - Improve comprehension.

Usage Drops Off Very Quickly After Initial Call



- After 5 months only ~5.5% of users still call into the system each month; after 10 months, only 3.8%; usage stabilizes at ~3% of users calling each month
- Small difference between radio cohorts and non-radio cohorts.
- Uncovering the underlying drivers of low retention requires additional research.

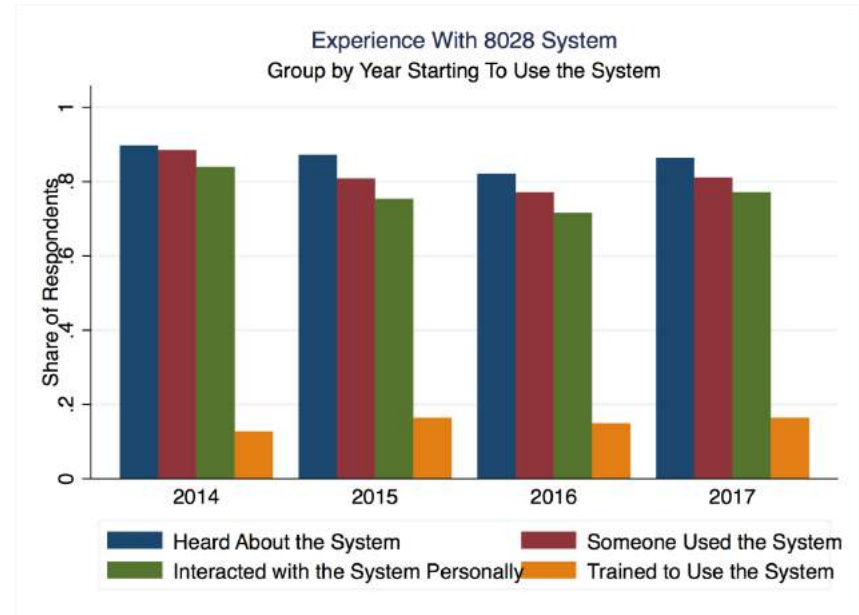


Cohort = all users who joined on some month

Qualitative Analysis Reveals Similar Retention Across Cohorts



- Hard to identify patterns of retention:
 - 2014 cohort recall system interactions slightly better than later cohorts
 - 2017 cohort mechanically remembered experience with the system better
- Better users are not more likely to know or remember interactions with the system.
 - About same probability of having heard, used or trained to use the system across groups of varying proficiency.
- Feedback loop: Back-checks to ask about experience with the system / reason for leaving.
- Potential A/B test: Push calls for retention



Comparison of Other ICT Extension Services



	PAD Gujarat	Large Indian Fertilizer Co	8028
# states, crops, languages	1/3/1	14/20/22	4/21/5
# farmers	51,000	1,700,000	3,100,000
Push calls per week	1 Customized calls	28 Calls not customized	0
Avg. Pick-up rate	82%	25%	NA
Avg. Listening rate	44-69%	<10%	NA
Unique inbound callers	62%	NA	100%
Repeat inbound callers	39%	NA	75%
Retention rate (year over year)	>90%	13%	22%
Content accessed on inbound calls	73%	NA	63%
Acquisition cost	\$0.25-0.91	NA	\$0.36

Technology – Preliminary Assessment



- **150 line capacity** blocks many users from accessing the system.
- **System outages** lasting more than one hour covered 2% of system up-time in 2017.
 - Short run: lost calls.
 - Long run: worse user experience.
- **System code and environment**
 - Development environment can be improved. Version control.
 - Make code modular, robust, remove duplicate code.
 - Separate testing environment.
 - Graceful shutdown / system-unavailable message.
 - Monitoring of system activity, downtime, rejected users.

Measuring System Impact



- Issue raised by Key Informants: The program does not have an impact monitoring system, so there is not yet concrete evidence of impact on:
 - Adoption of improved agronomic practices
 - Farmer productivity
- Important distinction between Monitoring & Evaluation (M&E) and Impact Evaluation:
 - Routine M&E can track system usage and user experience, as well as farmer behavior and productivity.
 - However, monitoring farmer behavior and productivity among system users does not provide insights on the system's impact on those outcomes.


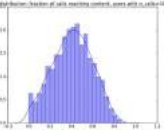
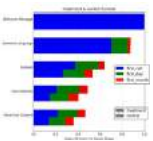
Context

Key Insights

➤ **Recommendations**

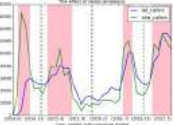
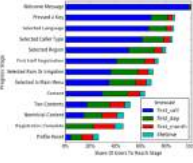


Path forward

Recommendations* – Continuous Improvement

	<p>1) Create Processes for Feedback Loops, experimentation, and course-correction. Calling into the system to test it out, talking to users to get feedback, qualitative interviews and field visits by staff for trickier issues, phone back-checks for inexplicable behavior.</p>
	<p>2) Mine Your Data Analysis of system usage data and monitoring of changes, helpful indicators in web dashboard. Analyze help-desk questions to find important information missing or inaccessible in the system.</p>
	<p>3) Create Systems for Experimentation & A/B tests Continuously perform A/B tests to improve system (e.g. training users, making profile reset less accessible, making user registration gradual/optional, recording aspirational stories, etc.). In content development, test on real users. Ask about challenges.</p>

* to be reviewed and prioritized with ATA to form the implementation plan

Recommendations – User Acquisition and Experience

	<p>4) Promote User Acquisition - Continue to invest in radio campaigns, try to improve timing, and explore new methods of user acquisition, such as peer recruiting, partnering with organizations that have recruited cohorts of farmers (farming collectives, input suppliers, etc.).</p>
	<p>5) Improve User Experience: Seamless first use of the system <u>Postpone registration</u> until after farmers have had time to get used to the system. Promote <u>different short-codes</u> for different languages. Include friendly introduction to the system in the first call to <u>provide training</u>.</p>
<p>Registration 10-15%</p> 	<p>6) Improve User Experience: Frictionless continued use Make profile reset less accessible. Remove other “trap doors” and snags. Make menu names more intuitive, and rotate them seasonally to highlight relevant content. Test tiny tweaks to make the system easier to use (repeating menus, cutting steps, fewer keys).</p>
	<p>7) Leverage Existing Extension System - Think about the <u>farmer <-> DA <-> 8028</u> triangle:</p> <ul style="list-style-type: none"> • 8028 can encourage farmers to contact DA about specific issues, and can explain its part in the extension system. • DAs can promote 8028, train & assist farmers, and give ATA feedback on the system

Recommendations – Content and User Retention

	<p>8) Simplify Content Make content easier to understand, with fewer technical terms and unfamiliar units of measurement. Structure the system to encourage users to access content that is most relevant to them.</p>
	<p>9) Customize & Expand Content Customize content by region, land size, soil health, water source, user preferences, user characteristics, level of experience, timely events, farmers vs. DAs, etc. Expand content to include new sources of information, e.g. soil health, water source, weather events, access to financial services, market information, etc. Improve data collection to make user data more reliable and only collect what is required.</p>
	<p>10) Target User Retention Invest in new ways of improving user retention, such as sending customized push messages, providing more advanced content, and continuing to conduct A/B tests to assess the effect of small improvements.</p>

Context

Key Insights

Recommendations

➤ Path forward

Path Forward

1. Implement selected recommendations

- a. Develop detailed implementation plan
- b. Create feedback loops
- c. Scale up selected A/B tests
- d. Simplify, customize, and expand content
- e. Enhance alerts and push calls

1. Create linkages with other ATA programs to increase impact

- a. Incorporate new types of information into IVR/SMS system
- b. Use other mechanisms to encourage behavior change, e.g. input vouchers and financial services
- c. Disseminate information to other stakeholders, e.g. input agro-dealers
- d. Use soil mapping and groundwater mapping to customize content by woreda

1. Conduct further research to improve program design and potential impact

- a. Continue A/B testing and experimentation
- b. Consider more extensive redesign of some system features

An aerial photograph of a vast green field, likely a golf course or a precision agriculture field. The field is characterized by numerous wavy, parallel lines that create a textured, undulating appearance. A dirt road or path runs diagonally across the lower portion of the image. In the center-right area, there are two small palm trees. The overall color palette is dominated by various shades of green.

Thank you!

www.precisionag.org