SECURING WATER FOR FOOD

Ignitia Impact Evaluation

Title: Impact Assessment of Iska SMS Weather Prediction on Farming in Ghana

SWFF Innovator: Ignitia AB

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September 2017

SECURING WATER FOR FOOD: A GRAND CHALLENGE FOR DEVELOPMENT

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Table of Contents

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I. INTRODUCTION

Weather prediction is very important for farmers in tropical countries ~~like~~ such as Ghana, where only ~~0.2 %~~two-tenths percent of farmland is irrigated. Updates from t~~T~~raditional ~~weather updates with~~ global weather models do not account for the micro-climates ~~existing~~ in these countries. ~~This~~ The unpredictability of tropical weather in these areas is exacerbated by climate change. ~~In order to~~To tackle this problem, Ignitia Ghana AB introduced a ~~location~~ location-specific short-message-service (SMS) system ~~(SMS)~~ called Iska.

Ignitia is among Securing Water ~~For~~ for Food's (SWFF's) ~~grant awardees~~innovators that are ~~and is on the~~expanding ~~phase of expansion~~ in West Africa. Ignitia partners with big telecommunication companies such as MTN to send Iska messages to Ghanaian farmers. ~~They~~ Iska charges ~~them~~ the farmers ~~8~~ eight pesewas ~~or~~, almost two U.S. cents, per SMS message ~~.~~ ~~They send simple SMS~~for a simple message in English ~~with~~ containing weather predictions such as "likely to rain" or ~~it is~~ "likely to be dry." Credit is deducted from the users' phone plans if they have credit available~~,~~; ~~otherwise~~if they do not have credit available, they will not receive the messages.~~–~~ The messages are sent early in the morning (as early as six o'clock in the morning) daily, weekly, monthly, or seasonally ~~early in the morning (as early as six six o'clock in the morning)~~. These SMS messages informing farmers about ~~the~~ weather patterns ~~and~~ are accurate for a ~~two~~ two-~~and~~ and-a-~~half~~ half-kilometer radius.

~~In order to~~To assess ~~the~~ Ignitia's impact and ~~the~~ success ~~of Ignitia~~ in securing water and food, ~~I~~ the researcher interviewed ~~fifty-nine~~59 farmers from a representative sample of ~~representative~~ Ignitia's paying and non-paying customer~~s~~ base. These interviews helped gather feedback from end users ~~on how~~ to make the SMS messaging system more useful and practical

Commented [K1]: No reference for small amounts in SWFF Editorial Guide, so we are following CMS:
9.20: Words versus monetary symbols and numerals
Chapter Contents / Numerals versus Words / Money
Isolated references to amounts of money are spelled out for whole numbers of one hundred or less, in accordance with the general principle presented in 9.2. See also 9.3.

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Commented [K2]: Moved phrase ahead to remove any ambiguity.

for farmers.~~–~~ The collected data helps Ignitia understand ~~the~~ shortcomings of the SMS predictions ~~thatthat the~~ farmers face ~~with the SMS predictions~~ and will help ~~them~~ the innovator improve ~~their~~ its innovation. Ignitia also can use ~~will be able communicate~~ this independent evaluation ~~to~~ to communicate with external organizations.

Commented [KF3]: [are these shortcomings the farmers face in their farming or shortcomings of the SMS predictions?

Commented [KF4]: [should this say a bit more about why they would want to use it to communicate with external organizations? What is the benefit of having this report? That type of statement is usually in an introduction.]

II. METHODOLOGY

~~The~~ The researchers collected the Iska user data ~~was collected~~ through a series of questions during interview sessions that lasted ~~for a period of~~ 20~~-~~ to 30 minutes on average. The researcher conducted -interviews in all ~~the~~ regions of Ghana~~,~~ except for the Northern ~~region~~ and Upper West regions, which previously were ~~previously~~ visited by SWFF Team Lead~~,~~ Dr. Ku McMahan and SWFF M&E Specialist~~,~~ Steve Simon. ~~Each~~ ~~We~~ The researcher recorded each conversation ~~was recorded~~ with a ~~mobile~~ smartphone and collected ~~(for~~ data ~~collection with~~with the Fulcrum app~~). The Fulcrum app~~, which allowed the researcher to record~~recording the~~ interviews ~~with no use of~~without using paper ~~. With mobile internet access, it allowed me to~~and upload ~~my interviews~~them in real time. ~~Some~~ As the external evaluator, ~~I~~ the researcher also recorded some of the conversations ~~were also recorded~~ with the ~~app~~ Easy Voice Recorder app, which allowed~~to allow~~ ~~me~~authentication of~~, as the external evaluator, to authenticate~~ ~~the~~ responses collected ~~in~~ with the Fulcrum app.

With the support of the SWFF M&E Specialist, ~~I~~ the researcher created a questionnaire covering ~~these~~ the following topics:

- ~~Background of the farmer~~ Farmer background

- Water usage/availability change
- Change in yield and ~~survival of the yields~~yield preservation
- Livelihood and income change
- Change in ~~in~~ amount of time Iska was used ~~in~~ for agriculture
- Affordability of the innovation
- Farmer's feedback ~~of~~ on the SMS messages ~~from the farmers~~
- Impact of the weather messages on poverty reduction
- Suggestions from ~~the~~ end users to Ignitia ~~ltd~~

Commented [KF5]: [not sure what this means – took a stab at clarifying]

a. Sample selection

Ignitia ~~LTD~~ provided a list of 6,300 randomized clustered MTN numbers ~~that they~~ identified as representative samples of customers. ~~I the~~The researcher used Google Fusion Tables to geographically map the numbers and locate exactly where each user was located. Then, for each of the Volta, Ashanti, Brong-Ahafo, Eastern, Western, Greater Accra, Upper East and Central regions, ~~I~~ the researcher selected numbers in the district ~~that had~~with the ~~most concentrated numbers~~highest concentrations of customers ~~in the Volta, Ashanti, Brong-Ahafo, Eastern, Western, Greater Accra, Upper East and Central regions~~ and called each ~~one~~ of the numbers.

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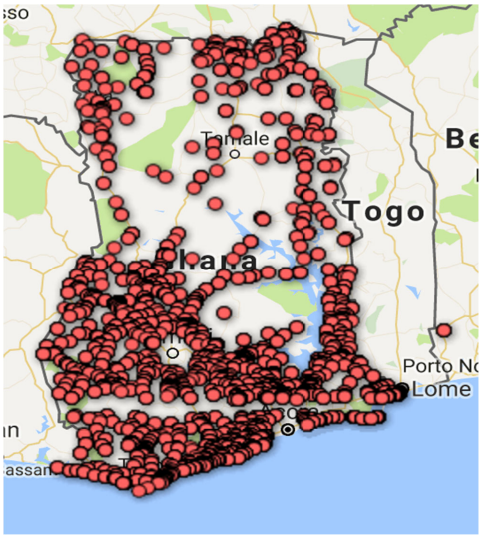

Image 1: Screenshot of all ~~the~~ 6,300 sample numbers

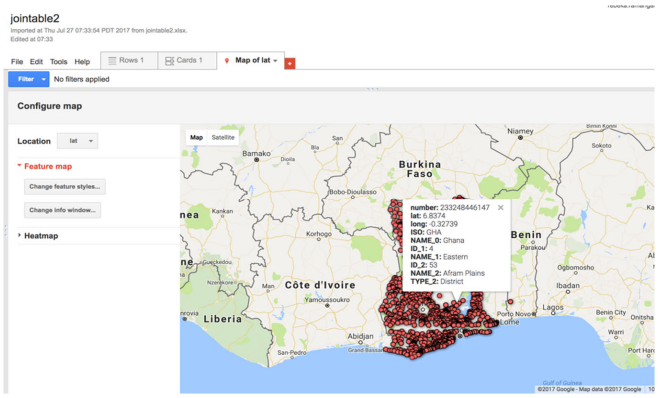

Image 2: Screen-shot ~~of one of numbers~~ with ~~their~~ district name ~~s~~ and other details for one of the numbers

~~I~~ ~~t~~The researcher called ~~the~~ each number~~s~~ to ask whether ~~they~~ the phone user had received a message with weather predictions, ~~saying~~ such as "~~it~~ It will likely rain" or "~~I~~It~~ikely~~

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will likely be dry." Then ~~I~~ the researcher asked ~~them~~ whether they were farmers ~~or not~~. ~~Later~~If the person was not a farmer, ~~I~~ the researcher ~~we would~~ explained ~~that~~ the messages were intended for farmers. If the answers to both questions were positive, ~~then we~~~~I~~ the researcher went ahead and scheduled to meet with the person, depending on their availability ~~on the arranged date~~. SWFF ~~also~~ required ~~the~~ potential interviewees to have received the weather messages for at least one season and ~~but~~ not more than two seasons prior to the ~~interview, and~~interview and required that both men and women were interviewed. Due to errors in the ~~numbers~~ phone number data, ~~our~~ the research sample ~~also~~ included users who had been receiving the messages for only a few months ~~only and those who had received the messages~~or for more than ~~2~~ two years.

Table 1: Summary of phone numbers ~~that were~~ called and ~~their~~ interview status

Region	Districts	Phone turned off	Number Incorrect	Did not pick up	Not on the service	On the service but not farmer	Famers receiving the SMS message	Meeting in person	Phone interview
Eastern	New Juaben	26	17	16	0	26	2	5	0
	Kwahu West	40	6	6	2	5	1		
	Kwahu South	68	9	10	1	21	2		
	Manya Krobo	32	6	6	1	10	4		
Ashanti	Adansi North	65	5	11	4	9	2	9	1
	Sekyere West	41	6	8	3	9	3		
	Asante Akim North	37	7	1	2	7	3		
Brong-Ahafo	Techiman	39	8	5	0	10	3	7	2
	Sunyani	73	26	5	4	18	7		
	Asunafo North	0	0	0	0	0	1		
	Asutifi	0	0	0	0	0	1		
	Berekum	16	20	6	0	10	0		
Western	Wassa West (Amenfi)	133	30	8	1	30	3	1	0
	Ahanta West	18	7	3	0	5	0		
	Shama Ahanta East	47	8	12	0	11	0		
Central	Cape Coast	27	2	4	0	9	1	11	1
	Mfantsiman	52	25	10	1	18	3		
	Awutu Efutu Senya	40	13	10	1	19	2		
	Agona	110	30	9	3	3	3		
Volta	Ho	45	13	5	4	19	5	5	1
Upper East	Bolga	5	0	0	3	0	3	13	0
	Bawku Municipal	14	0	0	3	4	6		
	Bawku West	17	0	0	1	1	14		
	Kassena-Nankana	6	0	0	0	0	4		
Greater Accra	Tema	10	0	1	3	0	1	3	0
	Dangbe West	42	5	6	3	0	1		
	Dangbe East	113	20	18	5	6	6		
	Ga West	19	0	0	0	0	0		

Commented [KF6]: [note: checked a couple of columns for accuracy in addition, but assume the spreadsheet SUM function is being used, so did not check all sums]

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For 59 percent% of the 1,934 numbers ~~we~~ the researcher called, the phones were turned off. The largest group of unavailable numbers was in the Western region ~~had the most numbers of phone numbers unavailable~~. The Upper East region had the least number of phones turned off. ~~12%~~Twelve percent (238) of all ~~the total~~ numbers the researcher called~~, or 238 numbers~~ were incorrect numbers. ~~160~~ One hundred and sixty people were busy or did not pick up their phones at the time of ~~our~~ the researcher's call, and ~~we~~ the researcher ~~would not know~~had no way of knowing whether those people were farmers ~~or not~~. Two hundred and fifty~~250~~ users said ~~that~~ they were not farmers and were not taking part in any farming activities. Finally, 45 of the people the researcher called said ~~that~~ they did not receive the messages ~~at all~~.

~~We~~ The researcher asked a few questions of some of the users who were not farmers ~~a few questions~~ to assess their experience with the messages. ~~We~~ The researcher asked ~~them~~ their occupation,~~,~~ since the researcher knew it was not farming~~. We~~, and then ~~we~~ asked ~~them~~ how long ~~they~~ the person ~~have~~ had received the messages ~~for~~ and how they had heard about and subscribed ~~and heard about~~to the Iska service. ~~We~~ The researcher also asked if ~~they~~ the person was~~are~~ benefiting from ~~receiving~~ the messages and ~~weather~~ whether they planned to continue receiving ~~the messages~~them.

Table 2: ~~Non-farmer~~Nonfarmer users' responses to ~~our~~ the researcher's ~~follow~~ follow-up questions

Name	Occupation	Length of Iska use	Marketing channel to Iska	Benefits from using the messages	Will you continue using the messages?
Kate	Trader	N/A	Push message	The message helps her ~~to~~ plan her day	Yes
N/A	Building contractor	Started today	N/A	N/A	N/A

Commented [KF7]: [in chart: BF top row and left column

Commented [KF8]: [fact check says Agona, Ho and Tema (and maybe Dangbe West and East) are towns and Bolga is an island, not districts – should column label be changed to District/Town/Island?]

Commented [KF9]: [fact check showed Sekyere West is now called Mampong Municipal District – okay, or need to change – or need to indicate with a footnote? (*Now called Mampoong Municipal District)]

Commented [KF10]: [many instances do not provide the numerical equivalent for percentages as requested in the SWFF Editorial Guide, but it may be too cumbersome to include it everywhere…you have the option to insert them if desired]

Commented [K11]: The report is written in many declarative sentences that sometimes makes it sound choppy. In some instances, as here, I have suggested combining sentences to minimize the choppiness.

Commented [KF12]: [do we need further identifying info in these table titles in case they are used separately? If so, may want to add name of report, source, and/or timeframe]

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N/A	Fisherman	Almost a year	Subscribed by himself	Helps him plan his day	Yes
Miriam	Hairdresser	A long time	Push message	It helps her plan her day	Yes
N/A	Mason	More than 3 years	Subscribed by himself	It helps him plan her day	Yes
N/A	VRA (Volta river authority)	3 years	Subscribed by himself	Helps him with his work	Yes

~~The 13% of total respondents'~~Phone numbers ~~who were~~for the non-farmer~~s~~ respondents were spread all ~~over~~ across the country. Most (96~~.4~~ percent)~~%~~ of ~~these~~ the numbers ~~Numbers numbers~~ were in the ~~Southern~~ southern part of Ghana. They also tended to be situated closer to big cities,~~,~~ such as Ho, Nkawkaw, Kumasi, Obuasi, Techiman, Takuradi and Cape Coast. ~~24.8%~~Twenty-four percent of non-farmers were in the ~~Eastern~~ eastern region, 18~~.~~ ~~4%~~ percent were in the ~~Western~~ western region, and 19~~.6~~ ~~%~~ percent were in the ~~Central~~ central region.

~~We~~ The researcher was~~were~~ ~~only~~ able to talk to only six non-farmer end- users. These ~~users were~~included a trader, ~~a~~ building contractor, ~~a~~ fisherman, ~~a~~ hairdresser, ~~a~~ mason, and ~~one~~ a ~~worked~~ worker for the Volta River authority. These users had seen the Iska ad and called *455# ~~by~~ themselves and subscribed. ~~2~~ Two of the ~~6~~ six nonfarmer respondents received a push message inviting them to subscribe ~~for~~ to the weather updates. All of the users who had used the messages for at least a year reported that the messages helped them plan their day and ~~their~~ activities. ~~5~~ Five out of ~~6~~ six non-farmer users reported ~~that~~ they would continue using the messages.

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Commented [KF13]: [no decimals as per SWFF Editorial Guide – correct?]

Commented [KF14]: [Takoradi?]

III. RESULTS

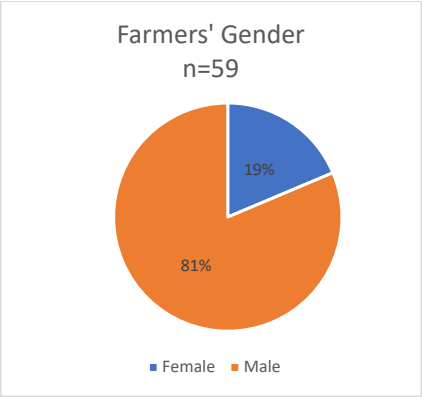
A. Background

1. Gender and literacy

Table 2: Literacy rate by gender

	Literate	Illiterate
Female	7	4
Male	33	10
~~Totals~~Percentage of respondents	76%	24%

Figure 1: Gender



Among the 59 respondents, 19~~%~~ percent ~~of them~~ were women and 76~~%~~ percent were able to read the messages on their own. Among the 14 respondents who could not read, four ~~of them~~ were women. Of the nonreading respondents,~~ For those who could not read,~~ 36~~%~~ percent ~~of the respondents~~ said ~~that~~ they received ~~the~~ help ~~of~~ from their children to read the messages.

Commented [KF15]: [numbers in chart add up to 54 (in-person and phone interviews) … should they add up to 59?]

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Commented [KF16]: [in literacy chart, should the literate percentage be 74%? (33 male + 7 female = 40 respondents; 40 divided by 54 total respondents is .74074 – or 74%)

Commented [KF17]: [Based on in-person interviews, should this number be 54? The literacy chart also adds up to 54]

Commented [K18]: Note: Track Changes isn't tracking changes in tables, but I am making the changes anyway.

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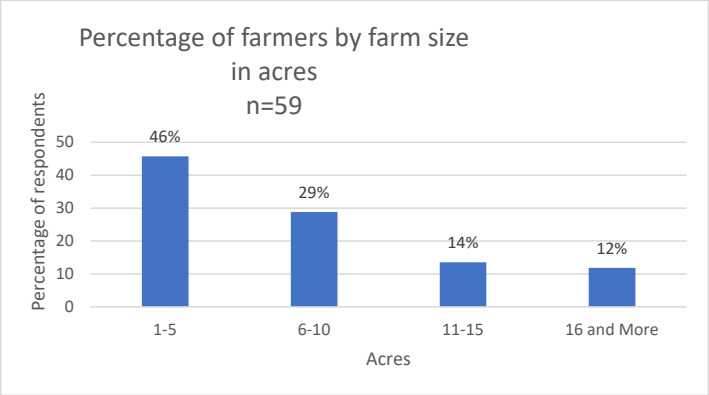
Commented [K19]: 76 percent of all respondents or the 19 percent who were women?

~~21%~~Twenty-one percent ~~other respondents~~ relied on the help of a friend. Only one female respondent reported that her husband read~~s~~ the messages for her.

2. Size of the farms

Figure 2: Size of ~~the total farm~~respondents' farms in acres



The 59 respondents owned ~~a total of~~farms totaling 605~~.72~~ acres. The smallest farm ~~size of a farm~~ was 1 acre, and one farmer owned ~~a total of~~ 61 acres. Farmers ~~have~~ own an average of 10¼~~.26~~ acres of farmland. The median size of the farms ~~were~~ was 6 acres, with a mode of 5 acres. Female farmers ~~have~~ own an average of 5 acres, which is 6½~~.5~~ acres less than the average ~~of~~ 11½~~1~~ ~~.5~~ of their male counterparts. However, the difference~~s~~ in means for the ~~two groups~~ genders is not statistically significant.

~~46%~~Forty-six percent of the 59 farmers own~~ed~~ less than 5 acres, or less than 2 hectares, and are considered smallholder farmers. These smallholder farmers own~~ed~~ ~~on~~ an average of ~~3.7~~almost 3-¾ -acres. For the ~~larger holder~~ farmers with larger farms, ~~the~~ farm size was an average -15~~.8~~ ¾ acres ~~on average~~.

3. ~~Experience of the farmers~~Farmers' experience

Figure 3: Number of years ~~of~~ farming

Commented [KF20]: [remove title in the chart, since there is already a text table; retain "n=59"]

Commented [K21]: In all charts: hyphens should be EN dashes with no spaces per CMS.

Commented [K22]: In chart itself: Couldn't resize the title text box. Would be best to have it all on one line with the "n=59" as a subtitle.

Commented [K23]: Percentages in chart add up to 101%, not 100%/

Commented [KF24]: [change "16 and more" to "16+"]

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Commented [K25]: Editorial Guide says not to use decimals or round up to the next number, correct?

Commented [K26]: medians?

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Commented [KF27]: [X axis label should be:] "Number of years farming"

Commented [KF28]: [In X axis, change "25 and more" to "25+"]

Commented [KF29]: In chart, change "25 and more" to "25 or more"

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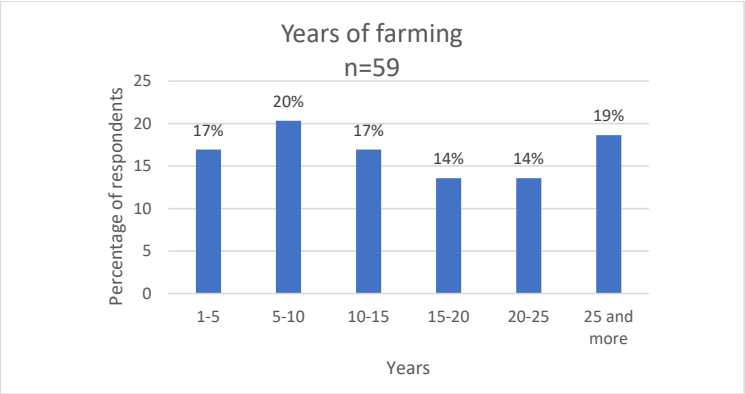


The 59 farmers have farmed ~~for~~ an average of ~~of~~ 15- to 20 years. These averages are ~~not very different~~similar for men and women. ~~17 %~~Seventeen percent of the farmers ~~started to farm~~began farming within the past ~~5~~ five years, and 19~~%~~ percent of the farmers have farmed ~~for~~ more than 25 years. ~~45% of~~Of the women ~~have~~ who are farmers, 45 percent have farmed ~~for less~~ fewer than 10 years ~~during our interviews~~.

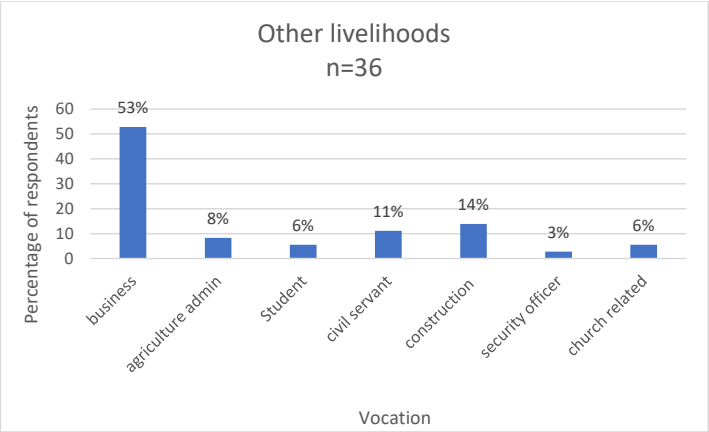
Figure 4: Other occupations of the farmers

Commented [KF30]: [remove one of the titles for consistency with all charts; check "n" as per previous comments]

Commented [KF31]: [delete one of the chart titles to be consistent with the chosen chart title style]

Commented [KF32]: [in chart: change "agriculture admi" to "agricultural administration" and put on two lines under the bar]

Commented [KF33]: [in chart: initial cap all X axis labels – first word only.

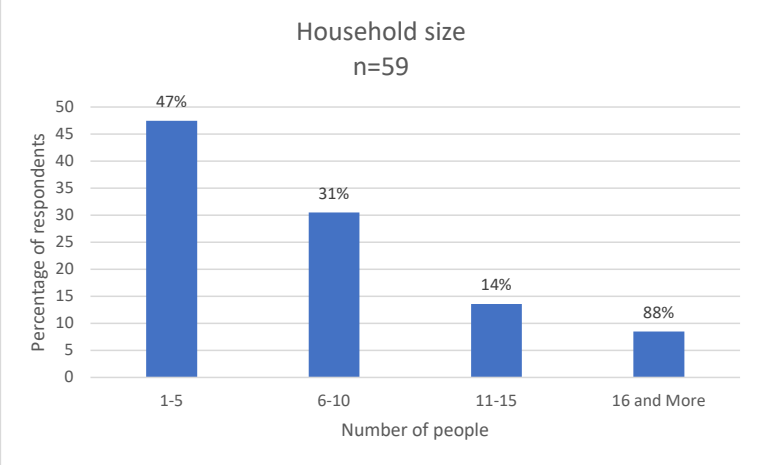


~~36~~ Thirty-six of the 59 respondents stated that they had other occupations ~~aside from~~in addition to farming. ~~53%~~ Fifty-three percent of those who have an additional job are in business and trade. Some of these farmers weave~~,~~ or ~~make~~ prepare food~~,~~ and then sell their product. The ~~next common~~second-most-common occupation was construction. ~~11%~~Eleven percent of the farmers also were ~~also~~ working for the ~~government of Ghana~~Ghanaian government. ~~8%~~~~Eleven~~Eight percent of the respondents also had administrative responsibilities within an agricultural association. ~~6%~~Six percent were still studying, and another ~~6%~~6 percent ~~had~~ fulfilled important roles within the church.

Commented [KF34]: [per SWFF Editorial Guide]

4. Family size

Figure 5: ~~Household size for the farmers~~Farmers' household size



The respondents had a total of 436 people in their households. On average, the household size was ~~7~~seven~~.39~~ people. The median was about ~~6~~ six people in the household. The smallest household was one farmer who lived by himself. The biggest household ~~had~~ included 29 family members~~ in the family~~. ~~47%~~Forty-seven percent of the households were ~~comprised~~ composed of ~~less~~ fewer than ~~5~~ five people~~ in the house~~. Only 8~~%~~ percent of the ~~respondents~~ households had more than 16 people~~ in their households~~.

5. Experience with Iska messages

Commented [K35]: Change "16 and more" to "16+"

Commented [K36]: In chart: change "16 and More" to 16+"

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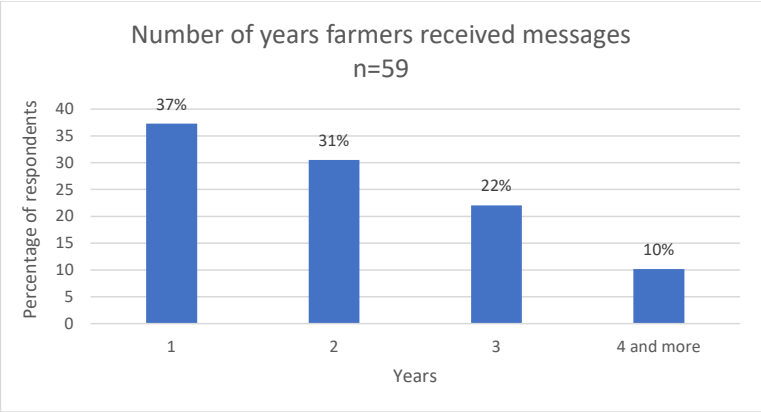
Figure 6: Number of years ~~of receiving~~farmers received Iska messages



On average, the farmers received the Iska messages for a period of ~~2~~ two years. However, only 37 percent of the farmers fulfilled SWFF requirements on the length of time they used Iska. Because of the ~~errors in the data received~~data errors, ~~we~~ the researcher interviewed farmers who ~~have~~ used Iska for more ~~or less than one year~~than two years. ~~Only 37% of the farmers fulfilled the requirements by SWFF on the length of use of Iska. The group I interviewed~~Interviewees also included farmers ~~that~~ who had ~~been receiving~~received the services for less than three months. ~~31%~~Thirty-one percent of the farmers ~~have~~ had received the messages since 2015. ~~22%~~Twenty-two percent of the farmers ~~have~~ had received the messages for ~~3~~ three years, and 10~~%~~ percent of the respondents ~~have~~ had received the messages for ~~4~~ four years or more.

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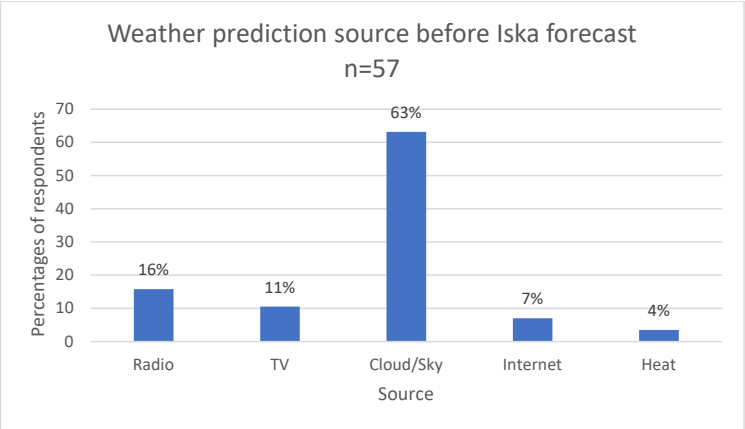
Figure 7: ~~Source of weather~~Weather prediction source before Iska



~~63%~~

Sixty-three percent of 57 respondents ~~relied~~ commented on what they ~~see~~ saw in the sky to predict the weather before Iska. ~~16%~~Sixteen percent of those farmers ~~used~~ listened to the radio and 11~~%~~ percent watched TV to ~~know~~ find out whether it was going to rain ~~or not~~. ~~7%~~Seven percent of the farmers relied on the internet to ~~know~~ detemine ~~whether it will rain or not~~the probability of rainfall. These farmers ~~had internet connection~~could connect to the internet on their phones and used Iska ~~simultaneity~~simultaneously. ~~4%~~Four percent of the farmers relied on the heat to know the weather.

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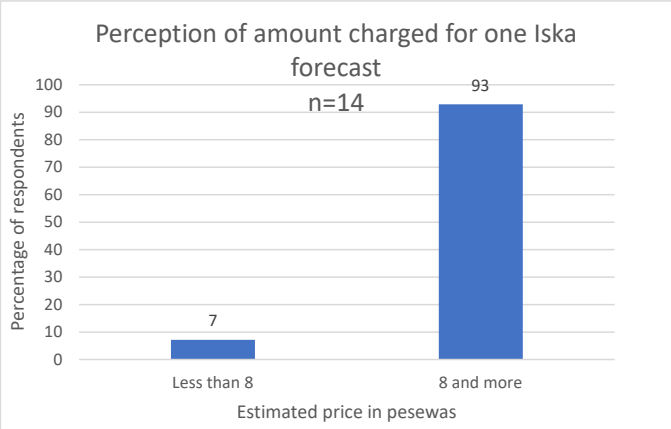
Commented [KF40]: 59? And should "57" in the chart be "59"?

Commented [K41]: [to fix repetition]

Commented [K42]: outdoor temperature?

Figure 8: ~~Perceived~~ Perception of amount charged for one ~~the~~ Iska messages



Among the 14 respondents who were willing to answer the question, no one ~~had the right answer~~answered correctly that Iska messages cost ~~8~~ eight pesewas. ~~93%~~Ninety-three percent of the ~~answers~~ respondents overestimated the price of an Iska message. Only one person ~~had~~ thought an ~~that~~ Iska message ~~was~~ cost ~~5~~ five pesewas ~~each~~, ~~which was also~~ lower than the actual price. The highest price ~~that~~ farmers ~~gave~~ estimated was ~~70~~ seventy pesewas, ~~which was~~ almost nine times the actual price. The mean ~~of this perceived prices~~perceived price was ~~36~~ thirty-six pesewas, and the mode was ~~50~~ fifty pesewas.

Figure 9: The value of ~~the messages~~an Iska message for ~~the~~ farmers

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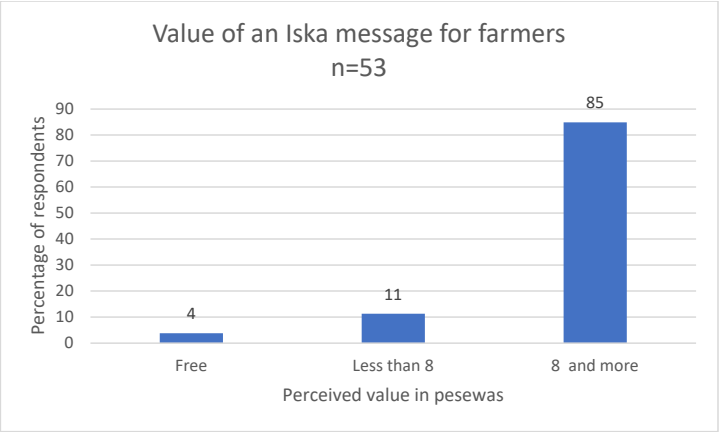

~~85%~~Eighty-five percent of the farmers said ~~that the~~each Iska message~~s~~ ~~are~~ was worth ~~8~~ eight pesewas or more to them. Only 14~~%~~ percent of the respondents reported ~~that the~~a message~~s~~ ~~were~~ was worth less than the actual price for them and ~~that~~ they suggested the price should be decreased. ~~4%~~Four percent of the respondents wanted the messages to be delivered ~~to them~~ for free. On average, farmers ~~are~~ were willing to pay ~~41~~ forty-one pesewas for each Iska message, which is ~~33~~ thirty-three pesewas higher than the current price. The median perceived value of ~~the~~ a message~~s~~ ~~is~~ was ~~20~~ ~~twenty~~20 pesewas, and ~~the is~~ the mode perceived value was ~~50~~ ~~fifty~~50 pesewas. The value of ~~the~~ a message~~s~~ ranged from ~~5~~ five pesewas to ~~500~~ ~~five hundred~~500 pesewas, or ~~5~~ five cedi. ~~12%~~Twelve percent of the farmers valued ~~the~~ each message at ~~8~~ eight pesewas, ~~like~~ the current ~~and exact~~ price ~~charged~~.

Figure 10: Marketing channels ~~to~~ for Iska subscription

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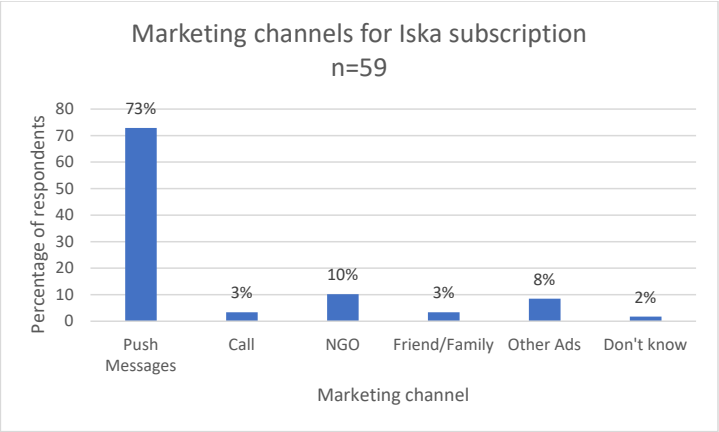

~~73%~~Seventy-three percent of the farmers signed up for Iska because they received a push message~~s~~ inviting them to do so. ~~10%~~ Ten percent of the farmers received the messages because NGOs subscribed them ~~for~~ to the message service~~the messages~~. ~~3%~~Three percent of the farmers signed up with ~~the~~ help ~~of~~ from a friend or ~~a~~ family member. Another ~~3%~~three percent received a call from MTN or Ignitia ~~to inquire~~asking whether the farmers would like to receive Iska messages or not. The remaining ~~8%~~eight percent ~~rest~~ signed up because they saw a poster advertisement ~~on the poster~~, heard a radio program about Iska, or heard about Iska ~~through~~ by word of mouth.

~~5~~B. Benefits of ~~the~~ Iska messages

~~a~~1. Benefits of ~~the~~ messages during ~~the~~ agricultural activities

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Table 3: Benefits of ~~the~~ messages during the agricultural activities

	~~have~~ Have you benefited from Iska messages? (%)	~~change~~ Changed seed sowing? (%)	~~change~~ Changed general cultivation? (%)	~~change~~ Changed harvest? (%)	~~will~~ Will you continue using Iska? (%)
~~yes~~ Yes	94.83	89.83	94.74	92.45	98.28
~~no~~No	5.17	10.17	5.26	7.55	1.72
Sample size	N=58	N=59	N=57	N=53	N=58

The farmers ~~show~~ claim an overwhelmingly positive experience with Iska messages, with ~~85%~~85 percent of ~~the~~ total respondents saying they ~~had~~have benefited from receiving the messages. ~~90%~~Ninety percent of the 59 respondents said ~~that~~ the messages helped them with their ~~seed~~ seed-sowing practices. ~~95%~~Ninety-five percent of 57 respondents said Iska messages help them with ~~decision~~ decision-making in ~~fertilizer~~fertilization, spraying and weeding practices. ~~92%~~Ninety-two percent of 53 respondents reported that they changed their harvesting practices based on the messages. Finally, ~~98%~~ninety-eight percent respondents said they will continue using the messages.

~~b~~2. Water usage/availability change

Those respondents who practice irrigation said they do see a positive impact on their water availability from using Iska messages ~~on their water availability~~. The two farmers ~~that~~ who relied on irrigation on top of rainfall ~~shared~~ said~~that~~ they ~~have~~ saved water. A man based in the Volta region saved ten 10-liter buckets, or about 200 liters, of water per week each time he

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~~would~~ watered his maize. ~~For a man based in the Volta region, he saved 10 buckets of 10 liter of water for each week. He saves about 200 liters of water per week for each time he would have had to water his maize.~~ The other farmer from the Upper East Region said ~~that~~ he ~~would~~ saved about six jerry~~-~~ cans or 208 liters of water ~~for~~ each time he ~~would have~~ had to water his farm. He saved at least 1,248 liters of water ~~in~~ each season.

~~c~~3. Crop survival

Table 4: Yields Before and ~~after~~ After Iska~~Yield for the respondents~~

Crop	Maize (100 kg bag~~ of 100kg~~)	Pepper	Tomato~~es~~ (72 kg crate~~ of 72 kg~~)	Cocoa (64 kg bag~~ of 64kg~~)	Cassava (91 kg bag~~ of 91 kg~~)	Rice (100 kg bag~~s of 100 kg~~)	Cashew (82 kg ~~Bag~~bag~~ of 82 kg~~)	Onions (xx kg bag~~s of onions~~)
Yield after	377.1	66.5	108	51.5	107.5	31	64	70
Yield before	312.1	32.8	59	49.5	40	12	26.5	55
Difference in yield	65	33.7	49	2	67.5	19	37.5	15
Sample size	23	8	5	4	3	3	2	1

~~78%~~Seventy-eight percent of the farmers surveyed reported that they saw an increase in ~~their~~ yields after they received Iska messages. The maize farmers, who raise crops in many different areas of ~~from all over~~ Ghana, saw ~~increases~~ an average increase of 2.83 bags of maize, up ~~of~~ from 23 bags the year before Iska, with each bag ~~23 bags~~weighing ~~of~~ between 100 kg ~~from~~ and 312.1 kg ~~the year before Iska with an average increase of 2.83 bags of maize~~. Tomato yields increased from 59 crates to 108 crates. Cocoa yields ~~saw a meager increase of~~increased a meager

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~~2~~ two bags. One onion farmer in the North of Ghana saw an increase of 50 bags of onions to a total -70 bags ~~of onions~~ after receiving the SMS messages.

d.– Change in income

Figure 11: ~~Income difference between income received before Iska and income in 2016~~Differences in annual income after receiving Iska messages

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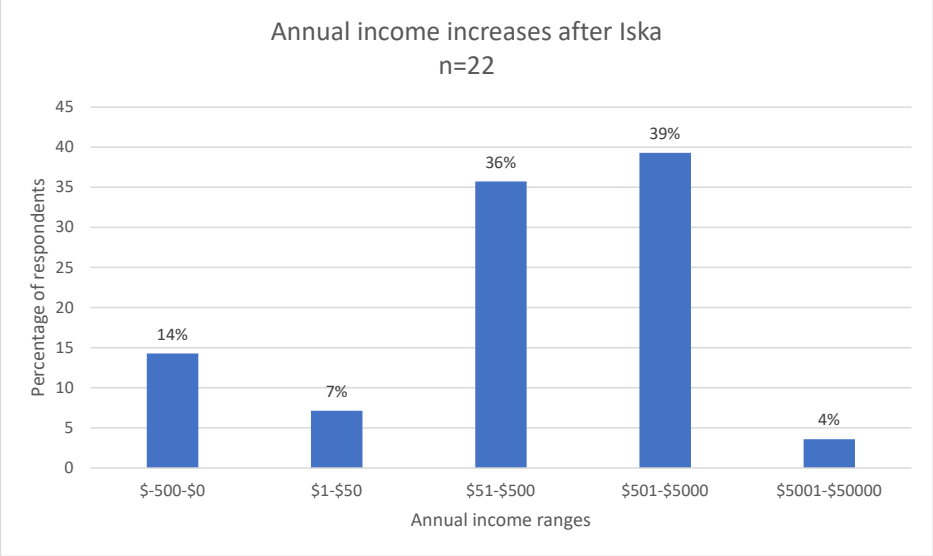

After the Iska messages began, the farmers were able to increase their annual incomes by a total $13,806. On average, ~~each of~~ the 29 farmers each increased their income by $476. The median was $168. ~~14%~~Fourteen percent of the farmers saw a decrease in their income after they received the messages. The ~~biggest~~ largest decrease~~d~~ was that of one farmer who ~~lost~~ brought in $463 ~~from~~ less than the year before he used Iska. ~~7%~~Seven percent of the farmers saw a modest increase of less than $50 after they received the messages. ~~36%~~Thirty-six percent of the farmers saw an increase between $51 ~~to~~ and $500.~~–~~ ~~39%~~Thirty-nine percent of the farmers saw an income increase between $501 ~~to~~ and $5,001. ~~in their income.~~ Finally, one farmer's income increased ~~their income~~ by $10,000.

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e. Extent of poverty for the Iska users

Table 5: 2016 ~~Income~~income ~~in 2016, according to~~by ~~the~~ wealth quantile~~s~~

	2016 income				
Wealth ~~Quantile~~quantile~~s~~	**$500 ~~$~~ – $1,000**	**$1,000 ~~$~~ –$2,000**	**$2,000 ~~$~~ –$5,000**	**$5,000 ~~$~~ – $10,000**	**Total**
1st	2	0	1	0	3
2nd	1	1	0	0	2
3rd	0	0	0	1	1
4th	1	0	0	0	1
5th	0	0	0	1	1
~~Number~~ Total number matched	4	1	1	2	8

STATA was ~~only~~ able to match only ~~8~~ eight 2016 annual ~~year~~ incomes (in the last season) with ~~8~~ observations of ~~the~~ wealth quantiles. ~~We could see that there are five~~Five farmers were in the bottom 40 percent of the wealth index. ~~3~~ Three of ~~these~~ the farmers at this level in the wealth index ~~have~~ had an annual income between $500 ~~$~~ and $1,000~~,~~; ~~1~~ one had an income between $1,000 and $2,000; - and ~~o1~~ none had incomes between $5,000 and $10,000. One person in the 4th-fifth percentile of the wealth index ~~receives~~ produced an income ~~of~~ between $500 ~~to~~ and $1,000 for 2016. Finally, there ~~is~~ was ~~1~~ one person in the fifth percentile, and that person ~~who received~~ produced an income ~~of~~ between $5,000 ~~to~~ and $10,000 last season.

f. Time ~~Saved~~ saved from using ~~the~~ Iska messages

Table 6: Time saved after receiving Iska messages

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		Sample ~~size~~size	Less ~~time~~ time (%)	Same ~~time~~ time (%)	More ~~time~~ time (%)
Plantation and ~~preparation~~preparation	Farmer	51	41.67	20.83	37.5
	Family	43	34.88	23.26	41.86
	Labor	50	57.78	22.22	20
General ~~plantation~~plantation	Farmer	53	40	20	40
	Family	47	35.71	21.43	42.86
	Labor	49	55.56	22.22	22.22
Harvesting and ~~Storage~~ storage	Farmer	53	47.62	14.29	38.1
	Family	48	65	10	25
	Labor	46	55.56	22.22	22.22

~~There are mixed responses by the farmers~~Farmers gave mixed responses indicating ~~weather~~ whether the messages helped them ~~farmers help~~ save ~~some~~ time ~~or not~~. Between 35- percent and 65~~%~~ percent of the farmers ~~saw that they somehow~~said they decreased ~~their~~ time spent farming in some way.~~-~~ Between 10- percent and 25 ~~%~~ percent of the farmers reported no change for any of the various stages of farming. ~~Between~~ From 20- percent to 45~~%~~ percent also saw an increase in their time ~~spend~~ spent in the fields.

Farmers ~~see~~ said ~~more~~ the greatest impact of Iska messages was in decreasing ~~their~~ time ~~consumed~~ spent in the fields ~~in~~ harvesting and ~~storage~~storing grain. ~~48%~~Forty-eight percent of the respondents reported that they ~~spend~~ spent less time on harvesting compared to ~~to~~ harvests before they received the messages. ~~65%~~Sixty-five percent of the respondents reported that their family members ~~now spend~~spent less time on this task after receiving the messages. ~~56%~~Fifty-six percent of the respondents also reported that their ~~labor~~ workers ~~spend~~ spent less time ~~in~~ on the farms during ~~the~~ harvest~~ing~~ time, after the messages.

Farmers ~~see~~ saw ~~more~~ additional tangible, positive differences in labor ~~work~~ after they used Iska. ~~57%~~Fifty-seven percent of the farmers ~~saw that~~said ~~their labor~~the work they

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performed after receiving the messages decreased ~~their~~ the time and effort~~s~~ they spent ~~in the field for~~on field preparation and ~~plantation~~ planting~~and preparation~~. ~~56%~~Fifty-six percent ~~saw~~ experienced the same general preparation and labor that they experienced before Iska.

g. Difference in ~~benefit of Iska~~Iska benefits for male and female farmers

Table 7: Difference in mean for ~~the~~ male ~~group~~ and ~~the~~ female groups ~~on~~ regarding use and benefit of Iska

Variables	G1 (Female)	Mean (~~female~~Female)	G2 (Male)	Mean (Male)	Mean Difference
Household size	11	8.727	48	7.083	1.644
Farm size	11	4.973	48	11.48	-6.507
Found Iska inaccurate	2	1.000	9	1.000	0.000
Saved time with preparation and plantation	9	2.333	39	1.87	0.407
Saved time with general plantation	9	2.333	41	1.927	0.462
Saved time with harvesting	5	2.400	39	1.692	0.708*
Changed ~~in~~ seed~~-~~ sowing behavior	11	1.000	48	0.93	0.062
Changed ~~in~~ general plantation behavior	10	1.000	48	0.938	0.062
Changed ~~in~~ harvesting behavior	8	1.000	45	1.042	-0.042
Saw an increase in yields	2	1.000	24	1.000	0.000
Increased ~~in~~ income	11	39.979	46	818.855	-778.876

Statistically speaking, the male ~~group~~ and ~~the~~ female groups ~~are~~ were not different from each other, ~~expect~~ except for the ~~*time*~~ *Time* ~~*saved*~~ *saved*-*harvesting* variable. Some of the variables, such as the household size or farm size, hold economic significance but are not statistically significant. The male farmers saved more time harvesting than their female counterparts.~~–~~ With "1" meaning ~~that~~ the farmers ~~spend~~ spent less time harvesting after receiving

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the SMS messages, "2" meaning they spent~~spending~~ the same amount of time, and "3" meaning they spent~~spending~~ more time~~ after receiving the SMS, the~~ than the female farmers ~~spend more time~~ harvesting~~ even~~ after receiving the messages.~~-~~ Th~~Th~~e mean of 1.69 for the male group~~ 1.69 for males and~~was significantly different than the mean of 2.4~~00~~0 for the female group, with a 90-percent confidence level~~, the difference is significant at the 90% confidence level~~. Women also seemed to ~~also~~ spend more time preparing and on general plantation, but the difference ~~is~~ was not statistically significant.

~~Other variables~~The numbers showed ~~some~~ a slight ~~economical~~ income difference between ~~man~~ men and women, but the difference ~~were~~ was not statistically significant. ~~The household of the females~~Female households ~~have~~ contained ~~more~~ 1.64 more people on average than ~~those~~ the households of the men in the study. The male group ~~has~~ owned ~~a~~ 6.~~5~~½ acres more farmland than that of the female groups. ~~9%~~Nine percent more male farmers ~~spend~~ spent less time preparing ~~his~~ their farms. Additionally, Iska helped 4.2~~%~~ percent more male farmers ~~to~~ change their harvesting behaviors than ~~the~~ females. There ~~are~~ were 6.2~~%~~ percent more women both changing their seed~~-~~-sowing behavior and changing their general plantation behavior as a result of using Iska compared to the male~~'s~~ group.

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h. Difference ~~with~~ in Iska experience ~~between the~~ – Southern and Northern Ghana

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Table 12: Difference in mean for ~~the~~ Southern ~~Group~~ and ~~the~~ Northern Ghana Groups on ~~use and~~ the benefits of using the messages

Variables	G1 (South)	Mean (South)	G2 (North)	Mean (North)	Mean Difference
Household size	46	5.826	13	12.923	-7.097***
Farm size	46	11.116	13	7.262	3.854
Value of the messages to the farmer	40	41.975	13	38.923	3.052
Increase in income	45	760.227	12	324.739	435.488
Saw an increase in yield	22	1.000	4	1	0.000

~~The~~ In a comparison of experiences using Iska in ~~North~~ north and ~~South~~ south areas of Ghana, the two groups ~~are~~ were not statistically different from each other, except for one variable: ~~which is the~~ household size. Households in Northern Ghana have ~~more 7~~seven~~.097~~ more people ~~than people~~ on average than ~~those~~ households in the southern part of the country. This is statistically significant at ~~the~~ a 99~~%~~ -percent confidence level.

Additionally, the ~~Southern~~ southern part of the country, on average, seemed to benefit more from the messages, but this is not significant statistically. The farmers in Southern Ghana reported ~~to have an increase of~~ 435.488 more ~~more~~ in income ~~from~~ for post-Iska yields ~~than~~ ~~those~~than income earned as a result of the messages in the Southern part of the country. ~~Additionally~~Also, the farms in Southern Ghana are, on average, 3.8 acres bigger than those in the north part of the country.

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i. ~~i.~~ Comparison between Ignitia M&E ~~of~~ in December 2016 and SWFF M&E in summer 2017

Table 13: Comparison between Ignitia M&E of December 2016 and SWFF M&E summer 2017

~~Item~~	Ignitia ~~Ignitia~~ M&E December 2016	SWFF M&E ~~summer~~ Summer 2017	Sample ~~size~~ Size – ~~for~~ M&E ~~summer~~ Summer 2017
Number of households in Ghana	71,049	2,849	1,995
Number of users in Ghana	248,672	19,943	80
Number of female users in Ghana	124,336	3,597	16
Maize	97%	27%	22
Rice	47%	158%	3
Soya	63%	86%	2
Number of hectares improved	116,272~~.00~~	28,176~~.61~~	59
Share of small-holders among Iska customers	0.33	46%	59
Share of non-small-holder farmers	0.67	54%	59
Average farm size for small-holder farmer, in ~~ha~~hectares	0.91	1.50	59
Average farm size for non-small-holder farmer, in ~~ha~~hectares	2	6.4	59
How much of women's work is unpaid? (positive)	Positive	Positive	
Who receives immediate benefits from the innovation? (positive)	Positive	Positive	
Who benefits from additional income earned from the innovation? (unsure)	Unsure	Unsure	
Whose tasks have been made easier in households? (p~~P~~ositive)	Unsure	Unsure	
Changes in access to land? (unsure)	Unsure	Unsure	
Level of women's leadership in the community (unsure)	Unsure	Unsure	
Percentage of customers who can afford Iska	100%	85%	
~~Mt~~ Metric tons (t) of produce	3.40	11.02	22

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Iska is reliable	79% (Nigeria)	71%	55
Iska is useful	82%(Nigeria)	95%	58
Iska helps plan activities	79%(Nigeria)	Na	
Iska helps with seed growth	81%(Nigeria)	90%	59
Iska helps ~~with~~ improve~~d~~ fertilizer and pesticide use	67%(Nigeria)	92%	57
Iska helps increase yield	77%(Nigeria)	78%	55

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~~The number~~A total 2,849 ~~of~~ Ghana households surveyed in this study used Iska ~~was 2,849~~ – ~~which is~~ only 4~~%~~ percent of the number reported by Ignitia ~~for~~ in 2016. ~~Based on this number of actual~~Actual number~~s~~ of users ~~were~~ also was lower, ~~and decreased~~ with ~~from~~ 19,943 people using Iska in 2017 compared to 124,336 in 2016. The average household size reported by Ignitia was 3.5 people, ~~which was~~ less than half ~~compared to an~~of the average ~~of~~ 7.39 ~~that I~~ the researcher found in ~~my the~~this survey. ~~Naturally~~A decrease in the total ~~size~~ number of ~~farms~~ hectares influenced by Iska ~~was affected by~~reflected a corresponding decrease in number of users. ~~The total farms that we~~This study found that ~~was~~ only 24~~%~~ percent of ~~what~~ the 28,177 hectares Ignitia ~~has~~ reported were affected by Iska ~~which is 28,177 hectares (ha)~~.

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Ignitia reported that only ~~1/3~~one-third of ~~their~~ the farmers served were small-holder farmers. However, ~~based on our~~the numbers in this study show that ~~actually~~ 46~~%~~ percent of Ignitia's clientele ~~the~~ own ~~have less~~fewer than 2 ~~ha~~ hectares (5 acres) of land~~or less than 5 acres~~. This study showed, o~~Also on~~n average, that the farmers own 1½~~.50~~ -hectares, which is more land~~higher~~ than the 0.91 ~~ha~~ hectares reported by Ignitia. ~~The percentage of larger~~Larger-~~-~~scale farmers ~~is~~ accounted for 54~~%.~~ percent of the farmers surveyed in this study. These farmers hold ~~an average~~ farms, on average, ~~size of~~ of 6.4~~ha~~4 hectares. The amount of produce generated per farmer is also higher in ~~our~~ the findings of this study – ~~which is~~ 11.02 ~~mt~~ t compared to 2.40 ~~m~~t reported by Ignitia.

The study showed no statistical difference in Iska benefits reported ~~We saw a similar result with what Ignitia had reported on the difference in benefit between~~ by men ~~and~~ compared to women~~'s experience with Iska. When tabulating the benefits of the messages for men and women, one cannot really see a statistically difference for male and female farmers~~. Men and women both report that ~~then~~ they benefit from the messages. The messages help both groups~~them~~ ~~in planning~~plan ~~their~~ activities and save ~~them some~~ time.

The Ignitia report did not include satisfaction feedback ~~of~~ from the farmers ~~for~~ in Ghana, but ~~included~~ did include satisfaction feedback from farmers in~~some for~~ Nigeria. The numbers collected in Ghana this summer are higher than those ~~of~~ collected for the Ignitia report ~~from~~ on Nigeria. ~~95%~~Ninety-five percent of respondents found ~~that~~ Iska was useful to them, compared to 82~~%~~ percent of respondents in Nigeria. ~~81%~~Eighty-one percent of respondents in Nigeria found ~~the~~ that Iska was helping their seed growth compared to 90~~%~~ percent of respondents in Ghana. ~~92%~~Ninety-two percent of respondents in Ghana found that the messages ~~the message~~ helped them improved their fertilizer and pesticide use. ~~77%~~Seventy-seven percent of users in Nigeria found that Iska messages helped increase their yields compared to 78~~%~~ percent of respondents in Ghana.

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IV. DISCUSSION

~~We~~ The researcher encountered issues scheduling appointments with farmers. Men and women reacted differently to ~~our~~ the researcher's calls. Conversations were smoother when a female translator talked to a male farmer and when a male translator talked to a female farmer.

~~We~~ The researcher was~~were~~ able to get a-hold of 81 farmers who ~~also~~ had received the messages, but not all of them were able to meet~~t with us~~. Some of them cancelled at the last minute. ~~They~~ Several farmers ~~would~~ canceled the appointments because of illness or a sudden need to travel~~s~~. For others, ~~we~~ the researcher ~~would lose~~lost the network signal as ~~we~~ they ~~got closer to~~neared their villages, and ~~other~~ or they ~~people have~~had their phones off when ~~we~~ the researcher ~~get~~ got close, so ~~and therefore~~ they were not ~~be~~ able to contact them. ~~Other~~ A number of people were ~~only~~ available only ~~at hours that~~after ~~we~~ the researcher had already left their districts.

When the farmers received ~~the~~ a message that it ~~will~~ would rain, they said they looked at the clouds or ~~feel~~ felt the heat to insure the accuracy of the message. This ~~gives~~ gave them ~~the~~ extra assurance ~~fro~~based on~~m~~ their own ~~expertise~~ experience ~~that~~ to believe that it actually ~~will~~ would ~~actually~~ rain and that the messages were correct. ~~Some f~~Farmers who had smart phones were ~~luckier and were~~ able to ~~know~~ determine the weather~~,~~ with more precision and get more details from the internet. ~~They~~ These farmers also compared what they saw outdoors with the Iska messages they received.

Many of the respondents confirmed the benefit of receiving the messages for their farming. The most popular benefit mentioned ~~is~~ was that the messages allowed them to plan their day and decide ~~the~~ what activities ~~that~~ they ~~will~~ would ~~do~~ engage in during the day. More generally, people talked about how the messages helped~~s~~ them decide whether to go to the farm or not. They specifically reported ~~how~~ they ~~are~~ were able to choose whether to weed, ~~to~~ apply fertilizer, or ~~to~~ apply chemicals based on the messages. Some also ~~refer to~~explained that ~~the experience~~using the messages ~~to~~ helped them save money, ~~by~~ because choosing to engage in

Commented [KF80]: [to remove repetitive "some"]

Commented [KF81]: [changed to remove repetition]

certain activities at the right time ~~decreasing~~ decreased their farming expenses. Others ~~talk about~~said the messages helped them increase their yields.

Commented [KF82]: [I guessed at this – correct?]

1. ~~usage~~Usage/~~availability~~ availability

Commented [KF83]: [could this section make it clearer why the messages were a benefit to those who irrigated and why the messages are not sent during the dry season?]

~~Since~~ Because 97~~%~~ percent of the respondents reported that they relied on rainfall to grow crops, Iska messages do~~es~~ not really make a difference ~~on~~ in water availability for most of the users. The remaining 3~~%~~ percent (two farmers) ~~percent~~ reported that they ~~have~~ saved water because of the messages. These two farmers did not ~~really~~ count how many times they needed to irrigate during the rainy season. They had a hard time quantifying the amount of water ~~that~~ they had saved, but ~~however noticeably~~said they noticed a positive change.

Many ~~other~~ of the farmers said they practice~~d~~ irrigation only during the dry season. However, Iska messages are not sent during the dry season. ~~Both farmers~~Farmers in both the South and in the Southern part of Ghana~~,~~ irrigate their onions, okra, tomatoes and other vegetables during this season.

Commented [KF84]: [what is the difference between "South" and "the Southern part of Ghana"?]

2. Crop yields or crop survival

~~The~~ According to the results of this study, Iska messages ~~also~~ helped~~s~~ crops survive and increased ~~with the survival of the crops and with increasing the~~ yields. ~~With the~~The messages during the rainy season~~,~~ helped farmers know what crops they should plant. They also helped farmers decide ~~know~~ how much fertilizer to use and ~~when they should~~the best time to ~~put~~ spray to allow the plants to grow well. ~~A~~ One farmer shared with us~~,~~: "About ~~4~~ three or ~~3~~ four seasons ago, the rain failed me. Now, with the messages, I am able to get more yield."

~~91%~~Ninety-one percent of the respondents changed the way they sowed their seeds based on the Iska messages. ~~The~~ This change in behavior ~~manifests~~ manifested in the type of seeds ~~that~~ they planted and when ~~to~~ they planted, as well as ~~their plants. They know as well how much~~ how much seed~~s~~ ~~to~~ they planted. The messages also allowed~~s~~ the farmers to decrease seed expenses, because ~~as~~ they ~~do~~ did not waste their seeds when they ~~know~~ knew ~~when is~~ the right time to plant ~~their seeds~~.

The increases in yield ~~that we~~ recorded for this study, however, ~~cannot~~ could not solely be attributed with certainty to the Iska messages. Nor ~~nor~~ could ~~we~~ the researcher determine ~~how much~~ what percentage of the ~~messages~~ yields ~~can~~ could be attributed to Iska messages. Since ~~our~~ the analysis is a ~~before~~ before ~~and~~ and-after analysis and ~~we do~~the researcher did not have a control group, the study can only provide~~only~~ an impact assessment ~~can work~~.

Many of the farmers ~~use spraying against~~spray for weeds and other pests. ~~32%~~Thirty-two of the 22 ~~of~~ respondents reported that they used more fertilizer ~~for~~ last season, and ~~with~~ 36~~%~~ percent ~~experiencing~~ experienced ~~less~~ fewer pests and insects (30~~%~~ percent saw no insects/pests at all). Additionally, about 35~~%~~ percent of the farmers ~~claimed~~ said ~~that~~ they ~~had~~ increased their plot size and that led to the increase of their production. Farmers decided to increase their plot size when they had good yields ~~from~~ the previous year or season.

Commented [KF85]: [specify season]

The Iska messages helped farmers ~~are also able to~~ plan their ~~seed~~ seed-sowing schedule for the rainy season to maximize ~~the~~ yields ~~that they harvest~~. ~~They~~ The messages helped them know what to plant and when, ~~to plant them~~ according to ~~this~~ an account from ~~this~~ one farmer: "Now I am able to know when to sow certain crops. It also helped me with the time of the sowing. For example, this month, rain is normal~~,~~. I am able to plant pepper, okra, and maiz."~~e".~~ For crops that ~~is~~ do not need seed-sowing, such as ~~like~~ cocoa ~~plantation~~, the messages helped the farmers

~~with timing of~~time ~~the trans~~ the hiring of workers to help ~~with nursing~~nurse and transplant~~ing~~ the plants. ~~A~~ One farmer said: “With the cocoa, as you do the transplant, you need the rain. If I get the information that it will rain tomorrow. I will make sure that the plant would be transplanted~~/~~ or nursed in time.”

~~The~~ Iska messages ~~also~~ allowed the farmers to be better prepared and more metho~~d~~dolog~~ical in their farming, which helped ~~for~~ them ~~to~~ increase their yields.~~–~~ For example, a farmer shared that the messages helped him ~~with the preparation of his~~prepare for seed sowing. ~~For example, with~~When ~~rice, when~~ he ~~gets~~ got messages ~~that it will say~~saying it ~~will~~ would rain ~~tomorrow~~the next day, he ~~will~~ prepared and sowed ~~the~~ his rice seeds ~~today~~that da, so ~~tomorrow~~ they would be ready for rain the next day~~it will rain on it~~. Another farmer ~~shares~~ shared that, ever since the messages started, she ~~started~~ began growing the seed uniformly, unlike before ~~which~~ when she sowed the seed in a ~~was messy~~nonuniform manner. She is now able to plant more and yield plenty.

The Iska messages ~~allow~~ helped the farmers’~~the~~ seeds ~~to~~ survive and ~~to~~ grow. Farmers ~~are able to~~can use the messages to protect their seeds from animals or insects that ~~will~~ eat the seeds if ~~the seeds~~ they are sown, ~~but~~ it ~~has not~~hasn’t rained ~~and~~, and ~~it~~ the ground is dry.~~–~~ One farmer said: “If it rains tomorrow, I will sow today instead of tomorrow, and I will not have to buy more seeds.” On the other hand, if it rains too much, the seeds can ~~also~~ wash away or be destroyed. ~~It depends on how the~~Each farmer’s ~~methodology~~ method of planting ~~the~~ seed depends on whether they ~~wait after the rain passes or right~~plant before or after ~~before~~ it rains, ~~but~~ and the messages help them decide ~~on~~ which day to ~~do so~~plant.

3. Change in incomes/livelihoods among end users

~~81%~~Eighty-one percent of the farmers who reported ~~before~~ before-~~and~~ and-after yields saw an increase in income ~~from~~ as a result of receiving the messages. The respondents saw a~~i~~n increase in ~~their~~ harvests of maize, rice, cocoa, pepper, tomatoes, cashew, and other crops.~~–~~ On average, the farmers saw an increase of $480 in income from the additional crops. ~~A~~ One farmer ~~shared~~ explained a tangible impact of receiving the messages for him: "Before the messages, I did not farm maize and millet. ~~We~~ We used to face food shortages. Now ~~they~~ we have some to eat and some to sell." The messages ~~helps~~ helped increase the income of the users.

~~For the~~The four farmers who saw a decrease in their annual income did not entirely attribute this decrease to the messages. One farmer reported ~~the~~ that pests ~~had~~ destroyed his maize farm ~~last season~~. Another farmer said ~~that~~ it was not that the daily messages ~~that~~ had failed him. He ~~but he~~ had stopped receiving the monthly and seasonal messages, ~~so~~ so he had could not ~~really~~ see the rain pattern anymore. This ~~had~~ led to the rain failing him towards the end of the season. He told ~~us~~ the researcher ~~that~~ the messages were accurate, but his yields decreased because he could not follow the rain pattern later in the season. The watermelon farmers saw crop ~~the~~ prices plummet~~ing~~ ~~of the price of the crop~~ in 2016. ~~This year~~It was a good year for the crop, which ~~had~~ led to a flooding of ~~the crop in~~ the watermelon market. A large watermelon ~~cost~~ was priced at ~~around~~ about ~~$4~~four dollars in 2015 and $1.25 in 2016.

~~Other than~~In addition to increasing ~~the~~ yields, the messages allowed the famers to alleviate ~~the~~ weather risks ~~in their farming~~ and increase their farm-land. Farmers claimed ~~that~~ they are now able to farm ~~in quantity~~more to increase their yield. One farmer said:~~–~~ "Yes, it helps me. Before the messages, I used to farm less." With the messages, he is sure it will rain tomorrow when ~~it~~ the messages say~~s~~ it will rain tomorrow. It encourages him to "farm large." Another ~~one~~ farmer added~~,~~ that it helped him ~~to~~ provide food security ~~with~~ for his family and even increase

Commented [KF86]: [it's a given that they destroyed the farm in the season during which the messages were received – if you say "last season", it's not clear whether it's that season or the season before…

Commented [KF87]: [what does it mean that the rain failed him?]

Commented [KF88]:

Commented [KF89]: [how did he know this if he couldn't see the messages?]

~~the~~ income for his family: “Before the messages, I did not farm maize and m~~M~~illet. We used to experience food shortages. Now we have some to eat and some to sell. It also allowed us to know to give some gaps in sowing the maize seeds to allow us to grow.”

~~By being able~~Because they can use the messages to ~~to~~ help them harvest their crops on time, farmers ~~are also able to~~can maximize the use of their land and ~~if possible~~possibly plant another round during the same season and increase their yields. During the rainy season, some farmers ~~we met~~ said they planted two rounds of maize ~~during the rainy season~~. As soon as the first one ~~is~~ was ready, ~~then~~ they prepared the land for the next one. With the messages letting them know how much rain will ~~be~~ fall during the season, they ~~are able to~~can better plan their first and second round, because they know they will ~~to~~ have enough rain to plant them. –“The messages help~~s~~ ~~him~~ me ~~to~~ optimize ~~his~~ my land use. If ~~he~~ I receive~~s~~ a message that says ~~in a month time~~ it will rain a lot in a month’s time, but now it is dry~~. He~~, I will harvest the maize quickly so ~~he~~ I can plant something else.”

The farmers ~~are also able to~~can use the Iska messages to help them save money by optimizing ~~their~~ the labor and harvesting equipment ~~that are~~ required by the harvest. Some of the farmers do not harvest when they receive a message that it will rain, so they can ~~and~~ avoid ~~the cost of~~ paying labors ~~who regardless of their effort during the day~~who cannot work due to the rain ~~would have to be paid~~. They ~~also do not rent~~also save money by not renting engines or machines for ~~their~~ harvest when it rains. This is a big source of savings for the farmers, because hiring a laborer costs ~~about~~ from 5- to 15 cedi every day. ~~Usually farmers~~Farmers usually hire between~~gher~~ four ~~up to~~and fifteen laborers per farm, which ~~is~~amounts to a lot of money for ~~people~~them. H~~For example, h~~iring a truck for a day to transport mangoes costs about 80 c~~C~~edi ~~per day to transport mangoes~~. A farmer ~~is able to~~can save the cost of the truck, the salary of the

Commented [KF90]: [this is the same quote as above – delete?]

Commented [KF91]: [not clear – can you change slightly to make it more clear?]

Commented [KF92]: [who is saying this? Add attribtion.]

driver, and the fuel ~~from~~ if they learn it is going to rain~~learning about the weather~~ ~~with~~ through Iska messages.

The messages also help~~s~~ the farmers save money by ~~allowing them to~~giving them the information they need to know ~~when~~ the best time to ~~best~~ harvest. This ~~allows them to not~~helps them avoid -wast~~e~~ing their crops and ~~save~~ protects them from pests and fungus. One~~A~~ farmer shared ~~that~~: "S~~s~~ometimes, when you harvest, the crops gets rained on and it spoils them. For example, millet. With the messages, ~~he is~~I am able to store them in time."

Farmers decide to harvest based on dry weather messages.~~–~~ For example, one~~a~~ farmer explain~~s~~ed how the Iska messages help~~s~~ ~~them~~ him time harvest right~~with the right timing of the messages.~~: "It helps especially with the maize. You have to harvest it dry. ~~They~~ We harvest the maize in one place and when it rains on the harvested maize~~. Some~~, some pests spoil the maize. With the messages, ~~they~~ we do not harvest until it is dry." Farmers ~~are able to~~can save money ~~from being~~when they are able to store their yields in time so ~~these~~ the yields do not spoil. This also helps them avoid ~~and from not~~ wasting money on inefficient timing of labor~~ing time~~.

The farmers ~~are also able to~~can decrease some of their agricultural inputs because of the messages. ~~91%~~Ninety-one percent of the respondents reported ~~that~~ they have somewhat changed their cultivation behavior based on the weather text messages they ~~have~~ received. Most ~~have~~ shared how they changed ~~their~~ the timing of fertilizer application based on the messages. A bag of fertilizer NPK 15 15 15 costs $29, UREA is $-20, and SOA is $6.25. These prices are the market prices for inputs across the entire country. However, the government has subsidized the purchase of inputs for ~~to~~ farmers, so the farmers only pay 50~~%~~ percent of the total cost and the government pays the rest. Farmers also save money by~~from~~ maximizing the timing of weedicide

application. Weedicide chemicals cost $0.20 per liter. A hectare of land requires at least 3.5 liters of weedicide.

5. Change i~~o~~n time spent on agricultural activities

Around 30~~-~~ percent to 40 percent~~%~~ of the farmers interviewed ~~see~~ saw a decrease in ~~their~~ time ~~spend~~ spent on agricultural activities. Another 20 percent to ~~-~~30 percent~~%~~ ~~perceived~~ said ~~that~~ they spen~~d~~t the same time after they received the messages as they did before on preparation and ~~plantation~~planting, general ~~plantation~~planting, and ~~-~~harvesting. ~~as before they received the messages. The~~Another 30 percent to ~~-~~40 percent~~%~~ saw an increase in time spent on agricultural activities after using the messages.

The farmers who spent~~d~~ less time working ~~in~~ on their farms use~~s~~ their Iska messages to optimize their time ~~use~~. ~~By~~ Because the messages help them plan~~planning~~ their day, they ~~are able to~~can choose to go to the farm or not. Many of them would not go sow ~~their~~ seeds ~~this~~ on a given morning unless they know it will rain ~~or~~ this evening or tomorrow. Some choose ~~the~~ a day ~~of seed sowing~~ after the rain ~~had passed~~passes to sow seed. The farmers also plan their days for other farming activities, such as weeding, fertilizer application, and harvesting.

~~We~~ The researcher reformulated and repeated the question for those who reported that they received the messages, but spent more time in the field~~. We tell them~~: "Since you now ~~you~~ know when it will rain, you are better able to plan your day and are able to focus your time on one activity. Do you still think you spend more time in the fields?" Some often keep the same response because they increased ~~their~~ the plot size for their crops. Others saw an increase in ~~their~~ yields, ~~so~~ which indicates they ~~spend~~ spent more time harvesting. ~~For others, they~~Still others perceived that their greater focus on work meant that they did more work~~focused work as more~~.

Commented [KF93]: Is this correct? Which 30 to 40 percent is this referring to?

Commented [KF94]: [reformulated it from what? Why?]

Commented [KF95]: [not sure how this is different – isn't the previous information about farmers who receive the messages?]

~~Because~~ In other words, because they worked harder for a more focused period of time, they ~~think~~ thought they were~~that this is~~ working more. ~~Our~~ The response~~s~~ choices did not account for ~~one~~ a response like this and, in hindsight, the researcher would have ~~labeled it to~~included a choice gathering information about farmers who work~~inged~~ for a longer period of time.

Commented [KF96]: [it's not clear what the additional choice would be in contrast with original question]

a. Difference in time saved by men ~~due to Iska between~~ compared to women ~~and men~~

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Men and women ~~do~~ did not save ~~have~~ significantly ~~differences~~ different amounts of~~in their~~ time ~~saved~~ with help from the Iska messages, except that ~~other than w~~women ~~spend~~ spent more time harvesting than men. The means of the male and female groups ~~was~~ were not different. The messages also help~~help~~ the women better plan their days and save time ~~from~~ preparing ~~the~~ fields and applying fertilizer and weedicide.

6. Affordability of Iska

In general, the current pricing is good for the Iska customers surveyed**.** Iska is affordable ~~for~~ according to 85 percent~~%~~ of the customers. These customers ~~have~~ valued ~~the~~ each message~~s~~ at ~~$0.02~~two cents or more. One of the four farmers who said they could not afford the Iska messages at ~~the~~ that time did not even know ~~that they were~~she was being charged for the messages. She ~~was~~ told ~~us~~ the researcher that even though she benefited ~~for~~ from the messages~~,~~ she was willing to unsubscribe now that she knows credit ~~was~~ is deducted ~~from~~ for her messages. ~~She~~ This farmer was not supported by an NGO. The other farmers ~~have~~ noted that the current price is too expensive for them and that ~~$0.125~~twelve and a half cents would be more affordable for them. To alleviate this problem, the poorest farmers should be connected ~~Connection~~ to an

Commented [KF97]: [this doesn't sound right compared to the reference to two cents, above]

NGO or government agency who would pay for the messages~~ should be established between these agencies and the poorest farmers~~.

7. ~~What o~~Other benefits ~~&~~ and problems ~~have~~ the farmers experienced during use of ~~the~~ Iska messages

The f~~F~~armers interviewed confirmed they ~~have been~~were able to use the messages to facilitate their daily tasks or roles. These benefits ~~do~~ did not differ for men and women. Some farmers shared that the messages helped them with their other occupations. One~~A~~ farmer shared that the messages also help~~s~~ him plan his bee-keeping activities. A fisherman shared that he does not go to the sea when he knows it will rain heavily or if there is another type of storm. A student and a civil servant shared that they do not bring an umbrella when they leave their houses if the messages received predict dry weather.

The messages help the farmers keep themselves, their famil~~y~~ies, communities,~~y~~ and ~~their~~ livelihoods safe. The messages are important in rural areas. Some farmers have to cross rivers and walk ~~miles and~~many miles to get to their farms. When it is going to be stormy, people decide to stay safe at home, and they share the information ~~to~~ with those around them. One~~A~~ woman ~~shared~~explained~~,~~: "Since I receive the messages, I can plan to go to the farm or not. Since it is a forested area, when it rains heavily~~,~~ the trees come down and it is windy, so I stay at home." Another one ~~shared~~said:~~,~~ "I try to be observant with the messag~~g~~es~~.~~. I don't go across the river to my farm if it says it will rain. I don't let my children out if it says it will rain. I also make sure that my animals are back at their house before it rains."

The Iska messages also help~~s~~ the farmers ~~to be~~stay safe ~~performing~~ as they perform ~~the~~ agricultural activities during ~~the~~ harvesting time. For farmers who use~~d~~ ~~very~~ sharp tools to

Commented [KF98]: [this material is a repeat of text above – does it need to be rephrased?]

Commented [KF99]: [to remove repetition]

harvest their product, the dry weather is necessary to avoid injuries. One~~A~~ farmer share~~s~~d with ~~us~~ the researcher:~~that~~ "F~~f~~or the cocoa, if I get messages that it will rain, I don't go. Since the harvest is with knives, it is very slippery when it rains, so ~~they~~ I might cut myself~~might cut themselves~~." ~~Based on~~Using the Iska messages, the farmers can keep themselves and their laborers safe and prevent accidents.

8. Customers below the poverty line

~~I~~ The researcher cannot ~~make a conclusion~~conclude to what extent Ignitia's customers are below the poverty line or how much Iska helps farmers below the poverty line, because ~~I did not have enough~~there was not enough data ~~to make this analysis~~available. Only 31 farmers shared their 2016 yields ~~in 2016~~. ~~I~~ The researcher could match these income differences with only ~~8~~ eight wealth data observations ~~data~~. From ~~my~~ this minimal data, ~~I~~ the researcher cannot ~~make an assessment of~~assess what percentage of Ignitia's customers are poor.

~~I~~ The researcher ~~had~~ encountered a number of challenges collecting ~~these~~ observational data, because ~~some of the times~~ the farmers sometimes ~~gave us an~~asked for -appointments -near ~~the~~ a road, in a bar, in a restaurant, in the market, or somewhere else ~~which~~ that ~~does~~ did not allow ~~us~~ the researcher to see and observe their homes ~~and did not allow as to observe their dwellings~~. ~~I~~ The researcher also conducted five phone interviews, which did not allow observation of the farmers' homes. This reduces ~~our~~ the sample size for the poverty assessment.

~~Additionally, I the~~The researcher encountered difficulties collecting yield data. Some farmers were very reluctant ~~in sharing~~to share their yields ~~with us~~. They found this question very intrusive. Others just were ~~just~~ not able to recollect how much they ~~were~~ had ~~harvesting~~harvested. ~~There some~~Some farmers ~~who~~ had only started receiving the messages

within the ~~last~~ previous six months ~~who did~~or had not received the messages for an entire year, and they could not make an assessment of how the messages ~~are~~ were impacting their yields.

There might be a bias in the sample of people ~~that we~~the researcher met, as well. Since ~~most of~~ these people would have had their phones on during ~~our~~ the researcher's calls~~. C~~, chances are ~~that~~ they have electricity at home and are able to charge their phones most of the time. These users might be somewhat wealthier than those who receive the messages but have their phones off ~~and receive the messages~~. However, if farmers have their phones off for most of rainy season ~~period~~, then ~~we~~ the researcher cannot really ~~saw~~ say how much ~~this~~ the messages ~~can~~ could benefit their farming, because with their phones off ~~as~~ they do not use the messages. ~~Our~~ The survey ~~then would reflect~~reflects only the benefits of ~~these~~ the messages for those who receive ~~the messages~~them on a daily basis.

Commented [KF100]: [deleted "most of", because I'm assuming if they were talking on the phone, their phones were on]

Commented [KF101]: [changed to present tense, because this is true no matter what the situation]

9. Benefits of the messages to the community

About 83~~%~~ percent of the farmers ~~had shared~~said ~~that~~ they share the messages with their communities. People ~~have~~ shared that they told their children not to go out when it ~~rains~~was going to rain or they suggested their neighbors not to go to the farms when they kn~~o~~ew it ~~will~~ would rain. Many of the Iska farmers are called the "weather-man" or the "forecast man" by their colleagues, family, friends, and neighbors. Some ~~have shared~~said ~~that~~ they ~~tell~~ told their neighbors not to dry their products when it ~~is~~ was about to rain, so ~~that~~ they ~~do~~ would not waste their yields.

The farmers mostly shared ~~the~~ information verbally when they happened to see other people, but ~~other~~ some ~~also go~~went out of their way to share the information. As mentioned, ~~about~~ many of the children ~~do~~ read the messages for their parents. Others ~~do~~ live a ~~little~~

farther distance from their parents and they called their parents when it is was about to rain. Since some of the older people cannot read, calling farmers could be the next another answer to this issue.

Other Some of the farmers have taken took the sharing of the information at to a higher level. One person belonging to one an agricultural association shares shared the messages with 70 of its members of the association by telling them in person, calling them, or forwarding the messages to some of those who can read. Another One person in Brong-Ahafo calls called his brother, who is works at the local radio station, to so his brother could share to with the entire community what the weather is was going to be. Another chief farmer who has a radio program in his community also shares the weather information to with his colleagues on the air every day at 9 a.m.

10. Comparison between Ignitia M&E of December 2016 and SWFF M&E of summer 2017

The difference in the M&E of Ignitia and our this impact evaluation rely heavily on is mostly found in the number s of customers that they have reported and the numbers that we have found. Since it is known that 59% percent of the phones numbers are off, we can deduce that the actual numbers of farmers in the area can be deduced. During our a meeting, with Ignitia staff, they reported that farmers only receive the messages when their phones are on and when they have credit on their phones. The 4% percent numbers that we found are farmers that are the most frequent users of the Iska messages and thats the researcher identified those farmers what we can as call users. I The researcher multiplied these 4% this 4 percent by xxxxxx for to

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Commented [KF103]: [something missing here?]

Commented [KF104]: [is this what was intended?]

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calculate ~~the~~ total farmland affected by the innovation, the number of people affected by the innovation, and ~~the~~ total yields ~~received~~improved.

~~Our~~ The Ignitia and impact evaluation numbers for farm size and yield ~~numbers~~ also differed ~~for the farm sizes and yields~~. ~~We~~ The impact study ~~found~~ calculated a larger farm size, on average, because ~~our~~ the sample was more representative of Ignitia's customers across the country. ~~We~~ The researcher ~~also~~ found that Ignitia had more smallholder farmers than Ignitia had reported, and the average farm size was ~~also~~ larger. ~~We also~~The impact study also found that the average yield was higher than reported, but ~~were~~ the researcher was not able to make any conclusions based on ~~our~~ the numbers.

Commented [KF106]: [not sure what this means]

Ignitia ~~had~~ reported that Iska increased ~~the~~ yield by 97~~%~~ percent for ~~the~~ maize compared to ~~a~~ the 27~~%.~~ percent reported in this impact evaluation. This difference could be attributed to the fact that ~~our~~ the impact study sample was more geographically representative and that ~~we had more~~there was a divergence in land size between the two reports. However, ~~our~~the impact study sample was smaller. ~~We~~ The researcher saw an increase of 158~~%~~ percent in rice yield after the messages compared to the 48~~%~~ percent increase in rice yield Ignitia reported~~for Ignitia~~. ~~Our~~ The impact study rice yield sample was ~~really~~ very small, and two of the farmers reported they increased their plot size, which means ~~does not allow us~~ the researcher ~~to~~ cannot verify ~~this~~ the ~~claim~~ number reported by Ignitia. ~~I~~The researcher also cannot ~~make a~~ claim that a 63~~%~~ -percent increase in soya production ~~is~~ can be attributed to the messages. ~~We~~ The study included only ~~had 2~~two ~~before~~ before-~~and~~ and-after observations for the rice yields and therefore the researcher will not be able to ~~make~~ draw a conclusion ~~off them~~.

V. CONCLUSION

~~Ignitia's reported~~The numbers Ignitia reported are different ~~than~~ from ~~those~~ numbers ~~found from our~~found in this study based on the interviews conducted ~~interviews~~ ~~in~~ May~~-~~ through July of 2017. Only 4~~%~~ percent of the ~~number of~~ farmers ~~reported by~~ Ignitia reported are ~~frequently~~ using the messages frequently enough to ~~actually~~ benefit from the messages. ~~Due to this difference~~Because of this, the ~~actual size~~ amount of land and the number of people impacted by Iska ~~is~~ are lower than reported. ~~45%~~Forty-five percent of ~~Iska~~ farmers who use Iska are small holder farmers. The ~~rest~~ remaining farmers hold farms larger than ~~5~~ five acres.

~~Iska farmers~~Farmers who used Iska reported that they benefitted from using the messages. These benefits do not generally differ ~~for~~ between men and women. ~~They~~ Farmers ~~are able to~~can plan their days based on the messages, and the ability to plan helps them ~~so they can~~ optimize ~~their~~ the timing of fertilizer, herbicide, and insecticide to ~~make~~ help their crops survive. The farmers reported that they saw an increase in their yields, which led ~~that lead~~ to an increase in their incomes.

~~Iska farmers~~Farmers who used Iska also ~~had~~ saw a decrease in ~~their~~ farming expenses due ~~the~~ optimization of their inputs. ~~By knowing~~Because they knew the predicted weather ~~prediction~~, ~~the farmers are able to~~they could save money ~~from~~ by not wasting fertilizer, herbicide, and insecticide. The farmers also ~~are~~ were ~~also~~ able to save money ~~from~~ by not hiring laborers and not renting machines, ~~like~~ such as trucks, ~~during~~ on ~~the~~ rainy days.

Some farmers saw an increase in ~~their~~ water availability and a decrease in time spent farming as a result of reading the messages. Additionally, ~~1/3~~one-third ~~-~~to ~~2/3~~two-thirds of the farmers reported that they, their ~~family~~families, or their laborers were able to ~~save some time by optimizing~~optimize ~~their~~ time spent on preparing ~~the~~ fields, cultivating, and harvesting.

Commented [KF107]: [lower than what?]

Commented [KF108]: [reported by Iska or this study?]

Commented [KF109]: [can we add a comment that explains why this is important here in terms of the conclusions of the study?]

Commented [KF110]: [that is quite a range – is there a more conclusive number? What explains the range?]

Iska is affordable for 85~~%~~ percent of the customers, but a financing mechanism should be implemented for the other 25~~%~~ percent~~others~~. Poorer farmers should be connected with ~~other~~ financing organizations such as the government or other social service organizations ~~working on social programs~~.

In addition to helping farmers with their farming, Iska ~~also~~ helps farmers with ~~their~~ other occupations and responsibilities ~~outside farming~~. Farmers who work in additional occupations, such as fishing or ~~other~~ bee-keeping, shared that the messages also help~~s~~ them plan their days with ~~this~~ these ~~other~~ activit~~y~~ies.

Iska not only benefit~~t~~ed individuals and their families but also ~~it~~ benefited ~~their~~ entire ~~community~~communities. ~~Farmers~~ The farmers who received Iska messages shared their information with ~~their~~ friends, family, ~~and~~ neighbors and sometimes everyone in their village or town. The messages help~~s~~ other members of the community ~~with planning~~plan their days, as well. ~~Additionally~~In addition, the messages help~~s~~ ~~the community~~ communities stay safe by ~~staying~~ keeping farmers ~~at~~ home ~~in case of~~during heavy ~~or stormy~~ rains.

Commented [KF111]: [changed to vary with "additionally"]

VI. POINTS TO IMPROVE

~~Here~~ Below is ~~the~~ a list of recommendations from Iska customers. ~~They~~ The recommendations are ranked by the frequency with which each suggestion was shared~~the most popular feedback~~. This information ~~is~~ was not different for men and women.

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Commented [KF112]: [the chart says "frequency"; however, the word frequency suggests a farmer could have mentioned the suggestion a number of times and each time it was mentioned would have been counted; instead of "frequency", do you mean "Rank according to number of interviewee suggestions" or something like that?]

Frequency/ Priorty numbers	Points to improve	Examples of what farmers have shared
1	More accuracy	"I want the accuracy to be improved. For example yesterday, the messages said it will likely to rain at night so he did not spray. The rain only came in the morning when he could have sprayed yesterday. " "Sometimes it says it will rain but rain does not come. Not often ... It is rains somewhere close but not where we are" " I have a problem with accuracy of the messages. The messages are wrong most of the time. I live and register for Iska somewhat farther from my farm in Ejura f. He calls his laborers to share the information but it is not often correct weather prediction for his farm."
2	Nature of the rain (windy, stormy, showers vs. heavy rain and so forth)	" Needs more details on the nature of the rain. Example: is it going to be windy He should know the nature of the rain such as wind, thunder, lightnings, ..." "He wants more specific information than likely or likely ... More of the nature of the rain. Use more symbol instead of simple messages. Simplify the messages. "SUNNY DAY". Also please add temperature, the amount of rain. Please say if it going to be showers vs. heavy vs. moderate. Also, please add the windspeed. You only spray on the wind direction. Sometimes, the messages fail them. It says it will rain but it is only showers. He would like the actual time when it rains to be added and also the duration." "The writing is is too small. Elaborate... Please include the temperature, what times is it going to rain. He wants the messages to tell him when he should go to the field and work on his farm"
3	More information about the season	"They want to know how long the rainy season is going to be so that farmers like do not keep planting new crop." "He would like more specific information: the season, if it started. Make it come twice a day to see if something comes up and it changes"
4	More options weather to choose daily vs. weekly vs. monthly	"He only receives the daily messages now. He likes when he receives the monthly messages to see the pattern of the rain. It is not that the messages fail him, it is that the rain pattern fails him. He will plant and then the rain will stop." "He wants to receive the weekly messages only once. He would like it to come more often."
5	Messages to come earlier than when is actually comes	"Sometimes he leaves the house and the messages have not come, he would like the messages to come around 5a.m"
6	More Signs and symbols	"He would like some sign/pictures that shows if it will rain or if it will be dry" "Needs symbols"
7	More options in local languages	"More local language options."
8	Messages should come during the dry season	"The messages should also come during the dry seasons"
9	Communications	"Update us about the weather through our website for a couple of weeks or a couple of months. Also, use Facebook to send weather updates."

Commented [KF113]: [see separate pdf doc with hand annotation of this chart]

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VII. APPENDICES

a. STATA commands for wealth Index

```
drop computer non_mobile_phone
factor toilet-roof, factor (1)
predict windex2
xtile wquint = windex, nq(5)
```